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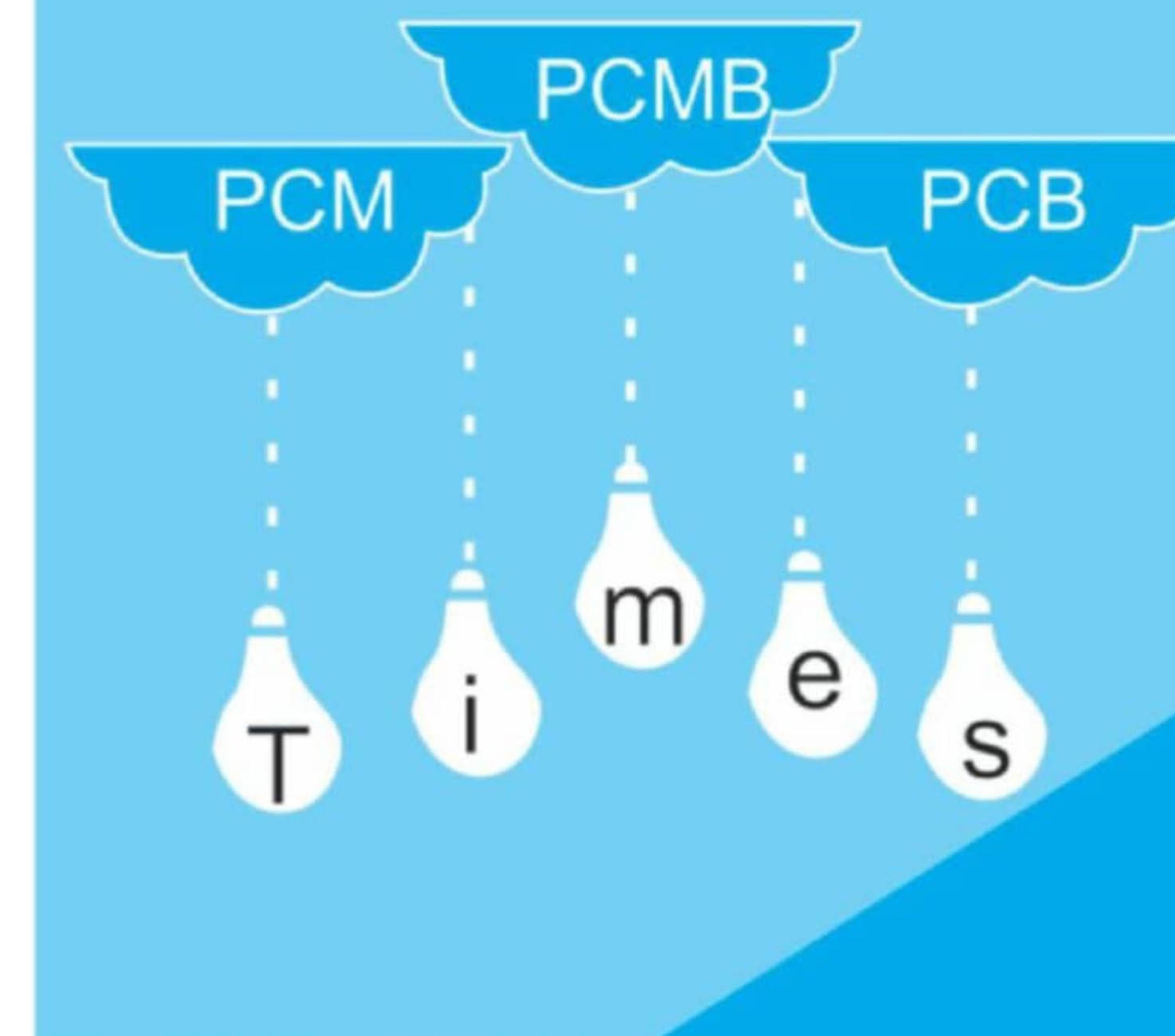
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Double Fertilization

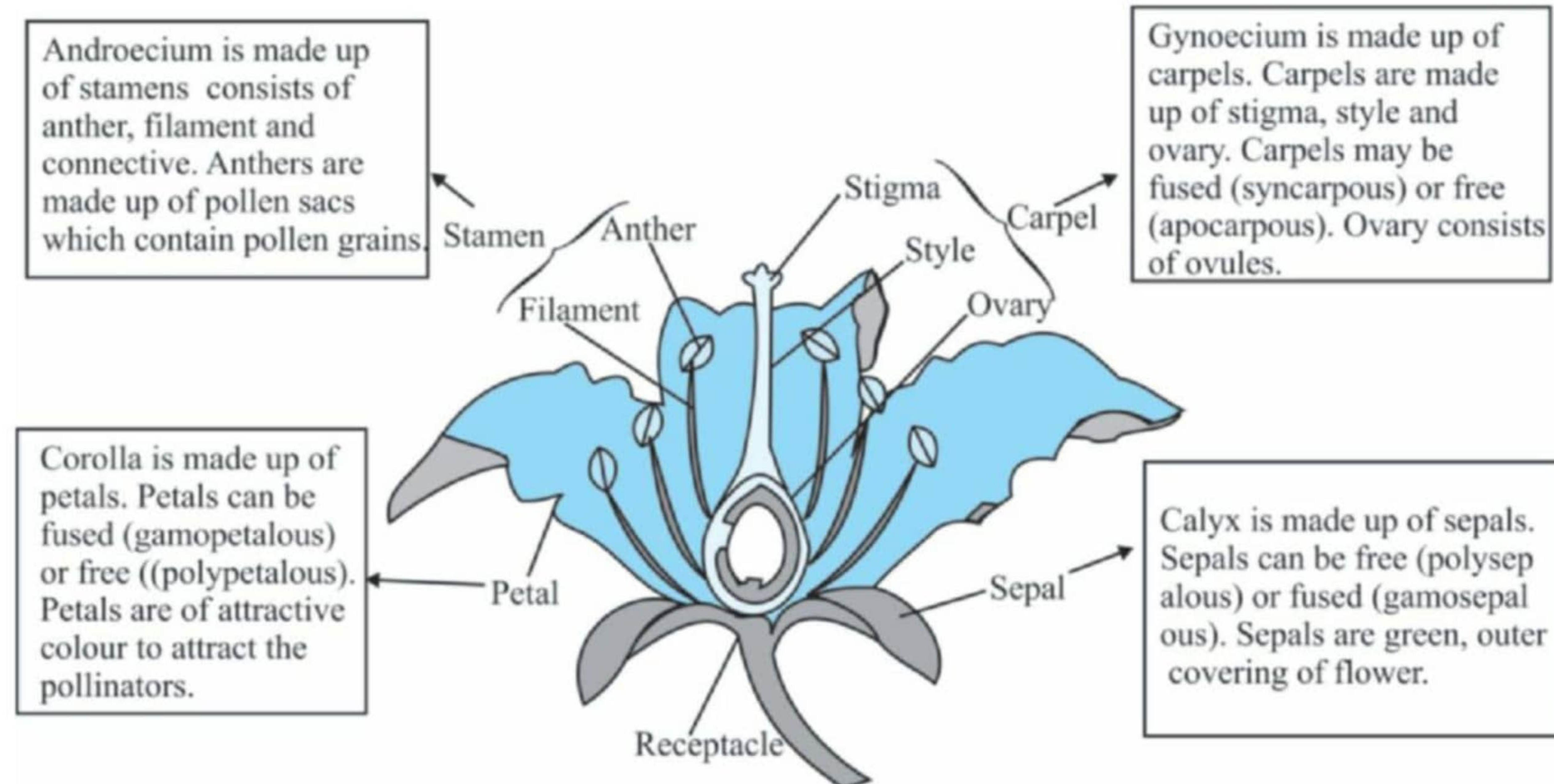
Concept of the month

This column is aimed at preparing students for all competitive exams like AIIMS, NEET, JIPMER etc. Every concept has been designed by highly qualified faculty to cater to the needs of the students by discussing the most complicated and confounding concepts in Biology.

By: Keshav pai (Mangalore)

Introduction

Sexual reproduction is a type of reproduction which includes formation of young ones by fusion of gametes. Angiosperms consists of specialized part for sexual reproduction known as flower. Flower consists of Calyx, Corolla, Androecium and Gynoecium.

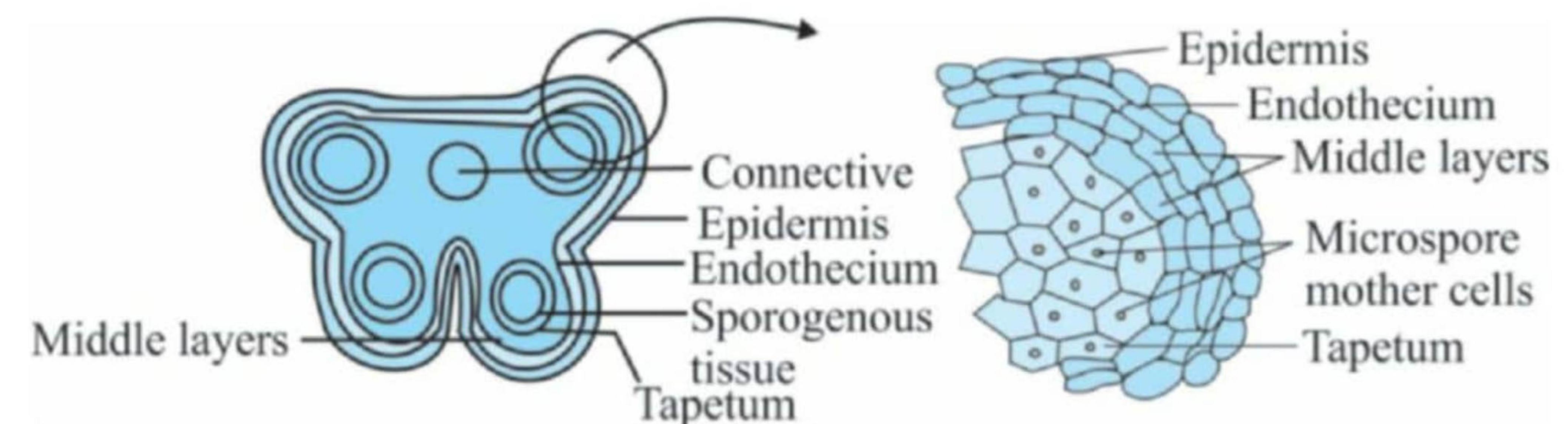


Pre – Fertilization Events

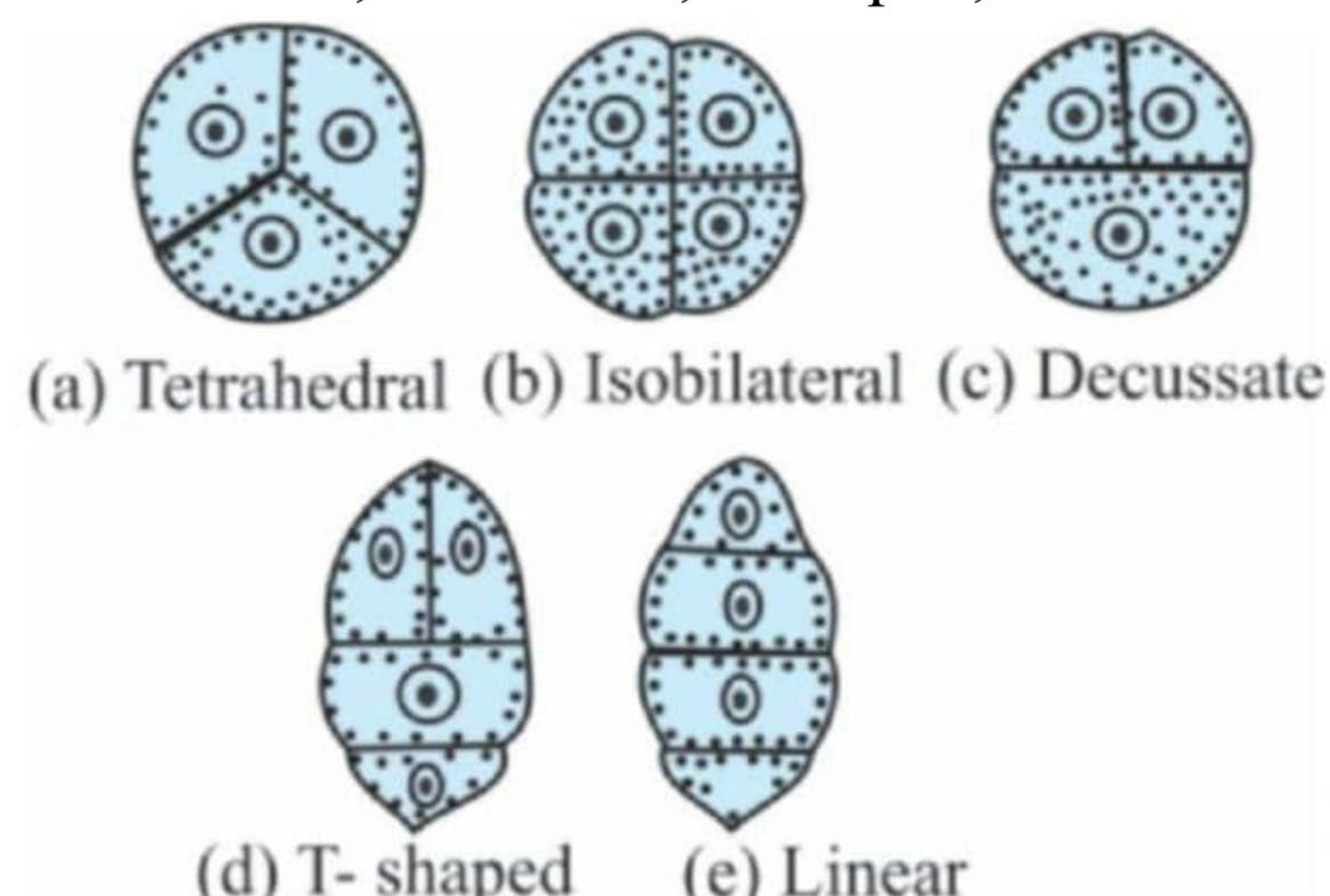
It includes all the events prior to the fertilization i.e sporogenesis, gametogenesis and pollination.

Microsporogenesis

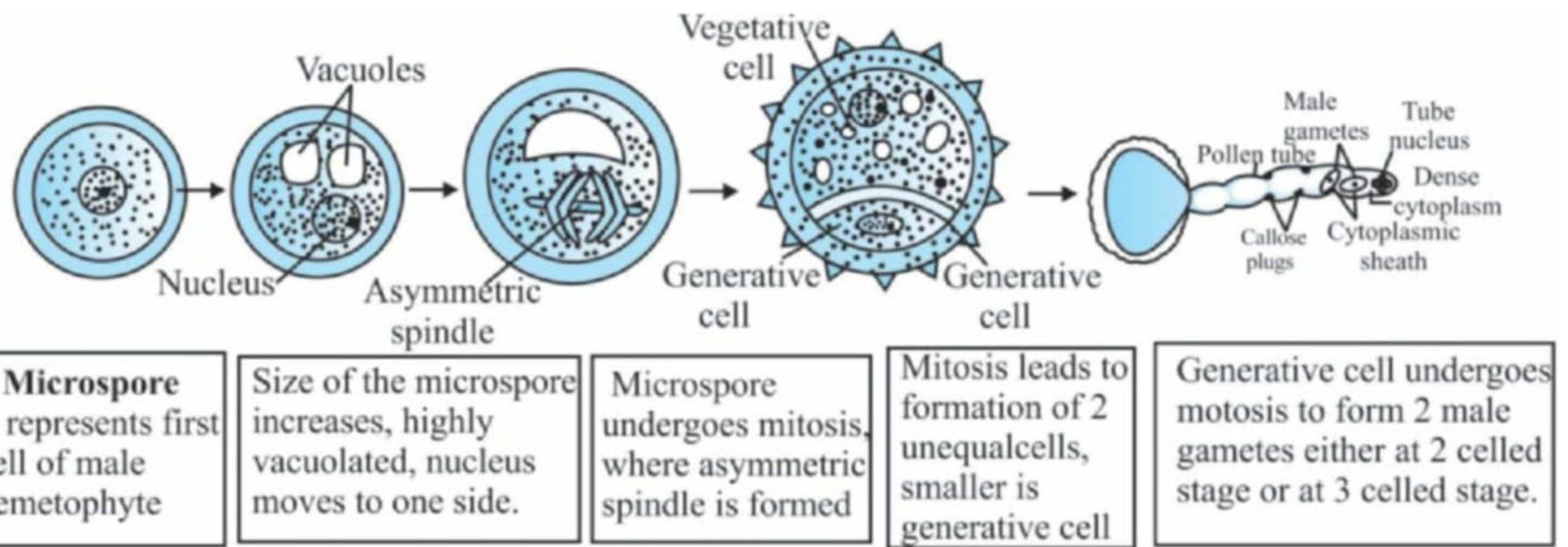
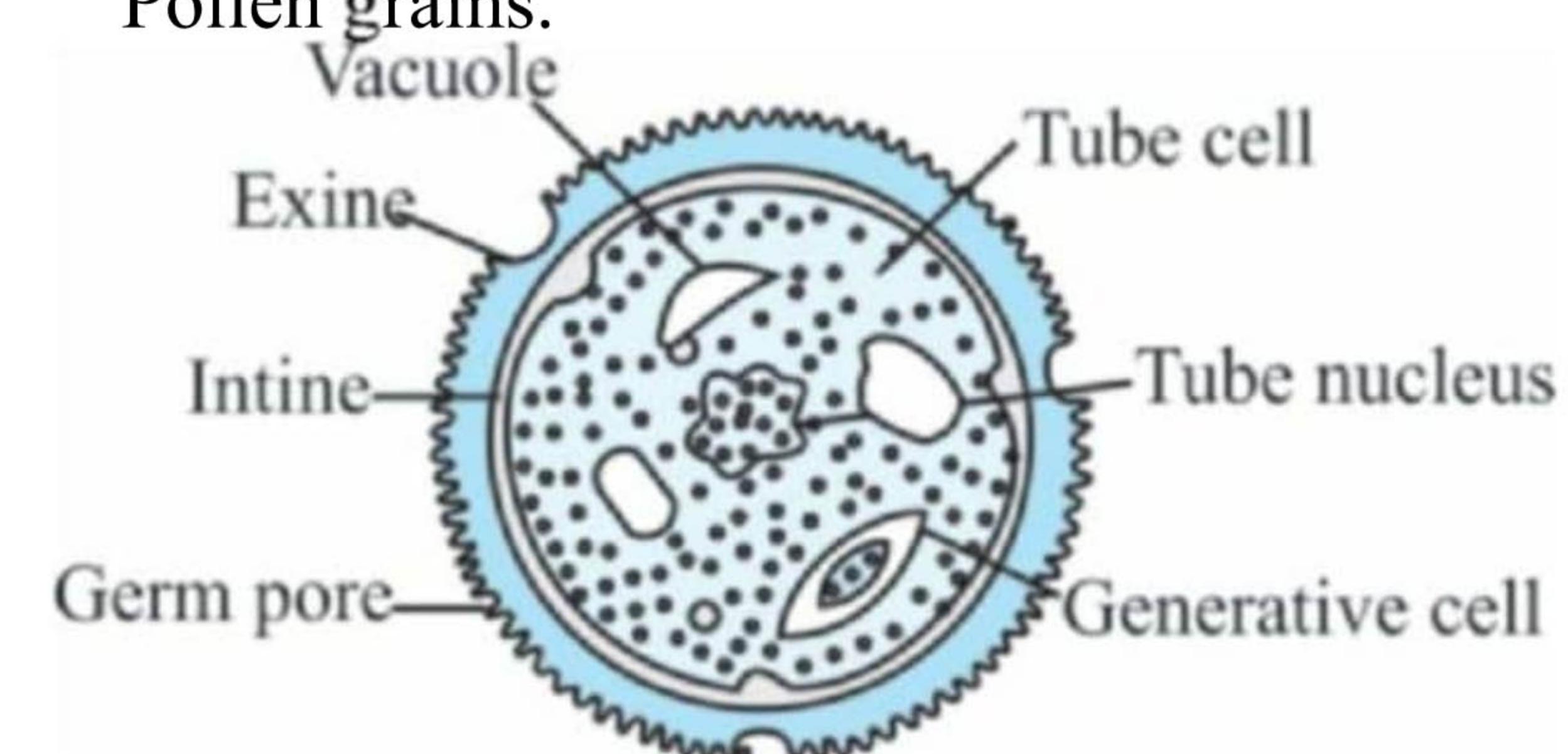
- The process of formation of microspores from a pollen mother cell through meiosis is called **microsporogenesis**. A typical anther is a tetrasporangiate where anther is bilobed and consists of four pollen sacs. Anther develops from homogenous mass of hypodermal cell. Hypodermal cells gets differentiated into archesporial cells. These cells contain prominent nucleus and abundant protoplasm. Archesporial cells divide periclinally and produce outer parietal cells and inner sporogenous cells. Parietal cells divide anticlinally and forms 2-5 layers Epidermis, Endothecium, Middle layers and Tapetum. Epidermis is protective in function. Endothecium helps in dehiscence. Tapetum cells are nutritive in function.



- Each cell of Sporogenous tissue is capable of giving rise to microspore tetrad and each one is Pollen mother cell (PMC) or microspore mother cell (MMC).
- Pollen mother cell (PMC) or microspore mother cell (MMC) undergoes meiosis to give rise to pollen tetrads which may be of different types, namely Tetrahedral, Isobilateral, Decussate, T-shaped, Linear.



- As the anther mature and dehisce, they dissociate and develop into pollen grains.
- Pollen grain has 2 layers, outer exine and inner intine. Exine is sculptured and made of sporopollenin (resistant to temperature and chemicals which makes pollens remain preserved).

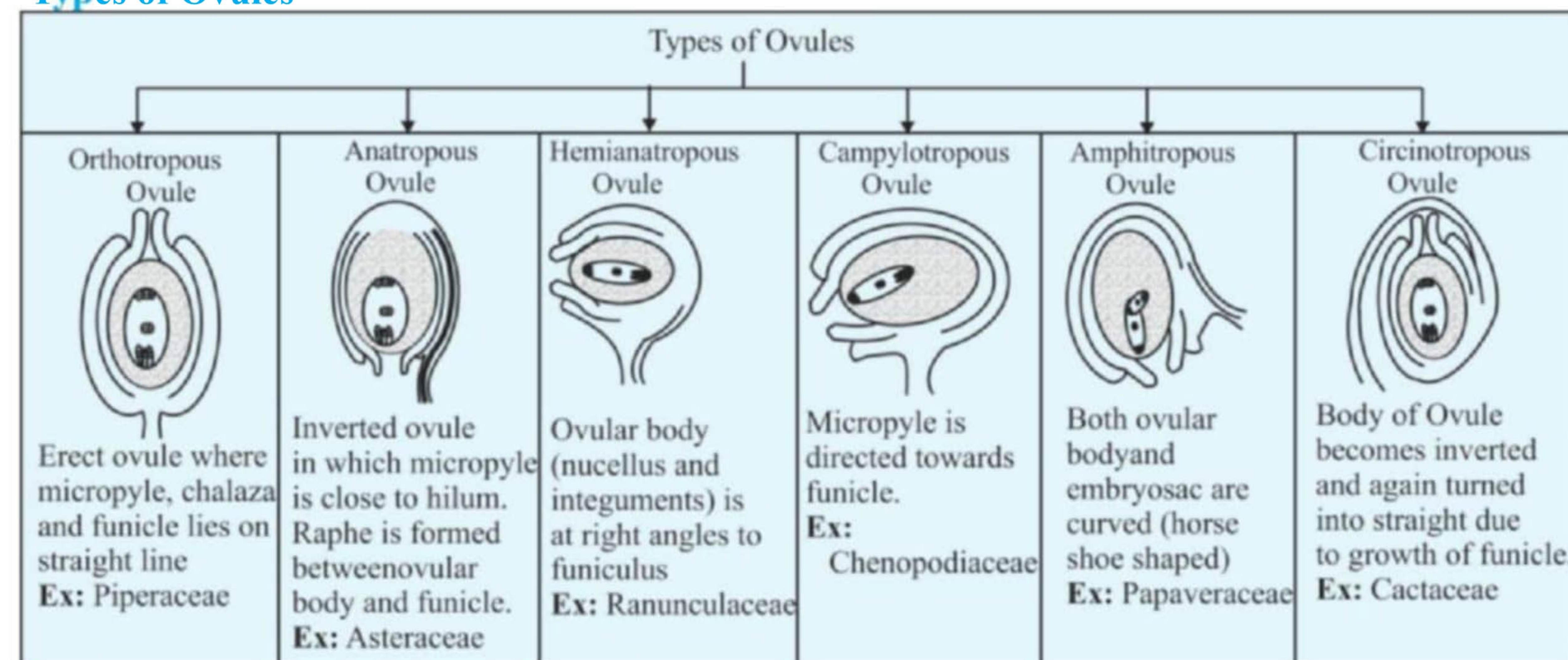


- At certain places exine remain thin and those areas called as germ pore. Sporopollenin is highly resistant material and non-biodegradable. Intine is made up of pectin and cellulose or pecto cellulose. Pollen grain mitotically divide and forms bigger vegetative cell and smaller generative cell.
- Vegetative cell has large nucleus and dense cytoplasm. In 60% of angiosperms, pollen shed at 2 celled stage. In remaining species, generative cell divides mitotically to give rise to 2 male gametes. Pollen grains are rich in nutrition. Pollen tablet and syrups are used as food supplement by athletes and by horses. Pollen of *Parthenium* is also a major cause of allergy.

Megasporogenesis

- It is the process of formation of megasporangium from megaspore mother cell. Gynoecium contains carpels. Each carpel contain Stigma, style and ovary. This process takes place in ovary especially in ovules.
- Ovule is an integumented megasporangium found in spermatophytes which develops into seed after fertilization. Each ovule is attached to the placenta by a slender stalk called Funicle.
- The point of attachment of the body of ovule with funicle is called Hilum.

Types of Ovules



Based on number of integuments, ovules are of 3 types

- Ategmic Ovule:** Nucellus is not surrounded by integuments. Ex: *Loranthus*
- Unitegmic Ovule:** Nucellus is surrounded by one integuments. Ex: *Helianthus*

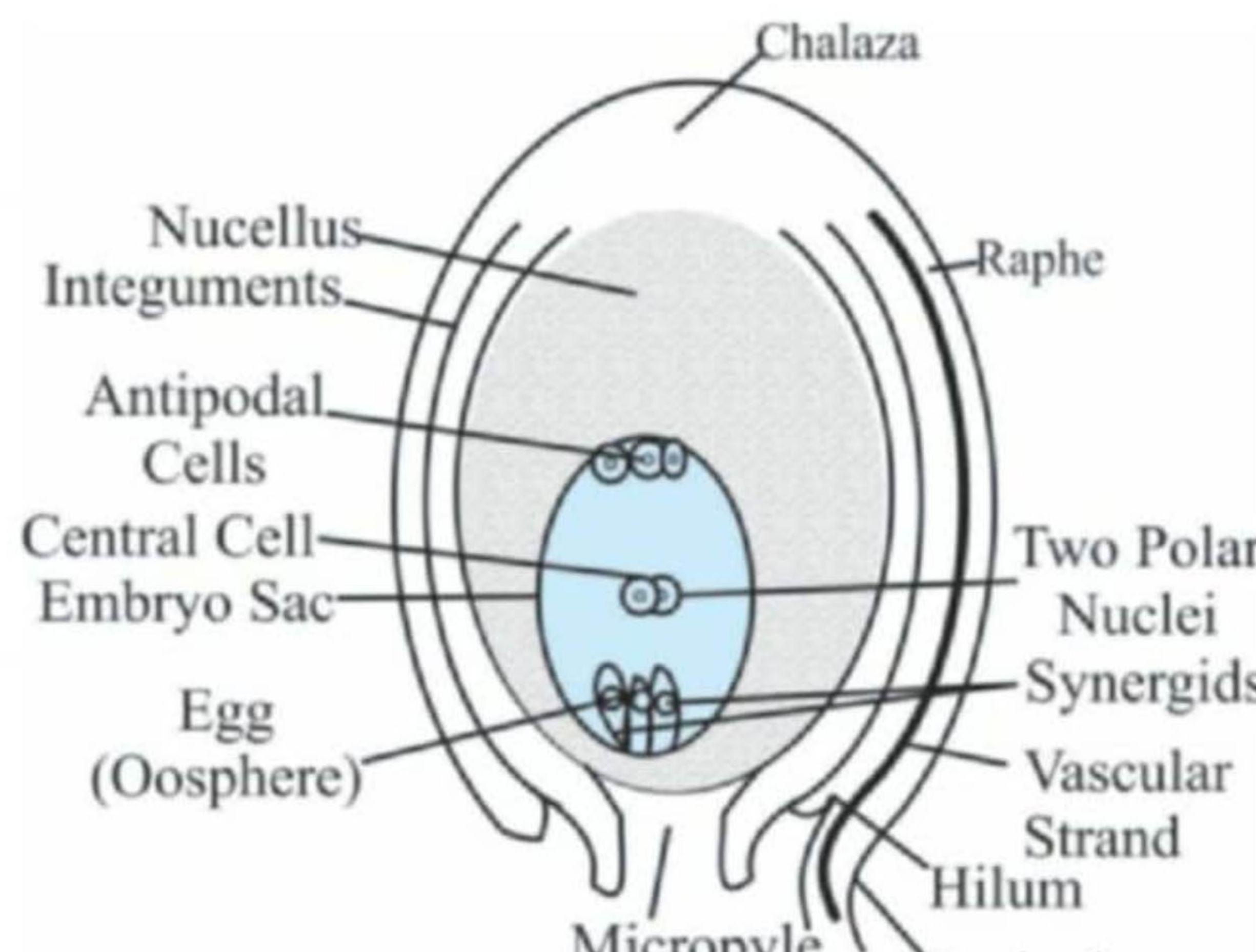


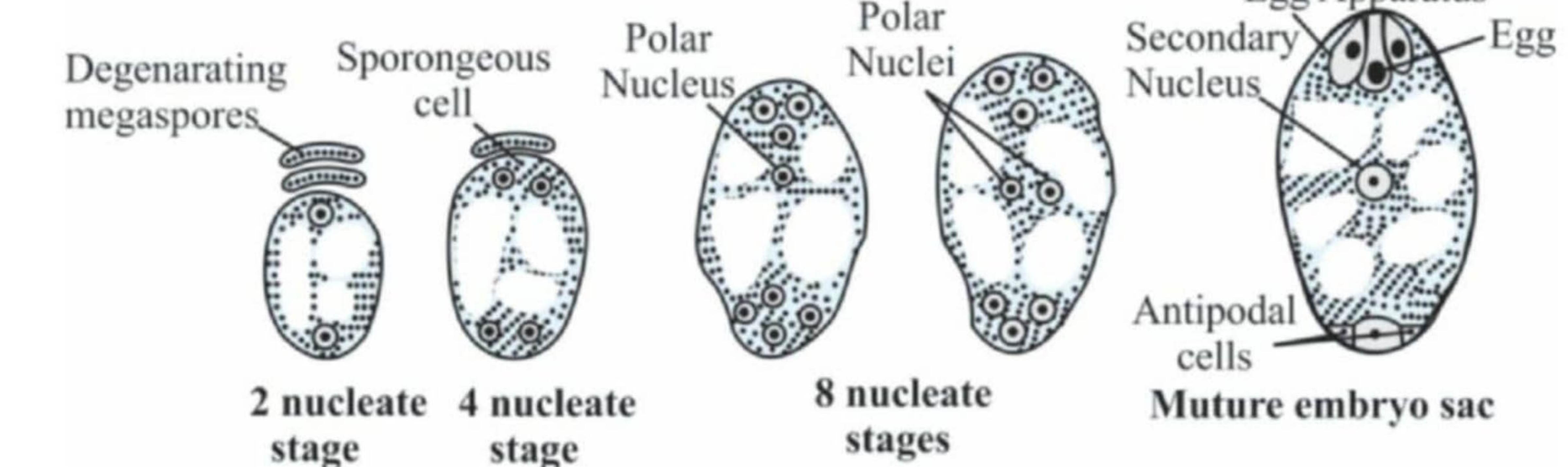
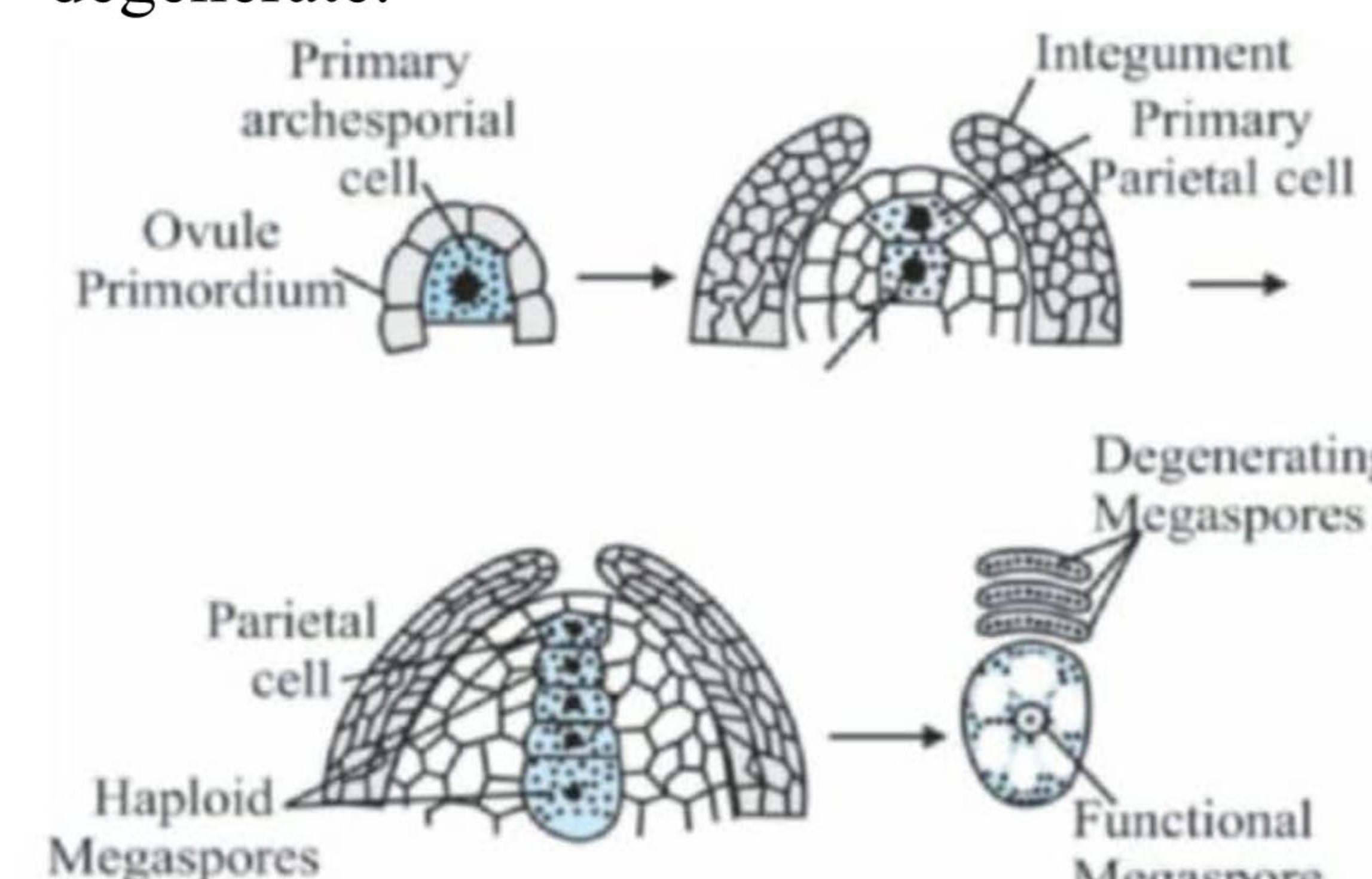
Fig: V.S of *Anatropus* ovule

- In a typical ovule, funicle is fused with body of ovule beyond hilum. It gives rise to a ridge called raphe.
- Ovule generally consists of central body of tissue called as nucellus which has abundant reserve food materials.
- Nucellus is surrounded by one or more integuments. A small opening left at the apex of the integuments is called as Micropyle.
- Posterior end of the ovule where nucellus, integuments and funicle fuse together is called chalaza. A large oval structure lies inside the nucellus called as Embryo sac or female gametophyte.

- Bitegmic Ovule:** Nucellus is surrounded by two integuments Ex: Monocots

Stages of Megasporogenesis

In the hypodermal region of nucellus towards the micropylar end, develops an archesporial cell. Archesporial cell divide periclinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megaspore mother cell (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megasporangia. Only chalazal megaspore usually remains functional and other three degenerate.



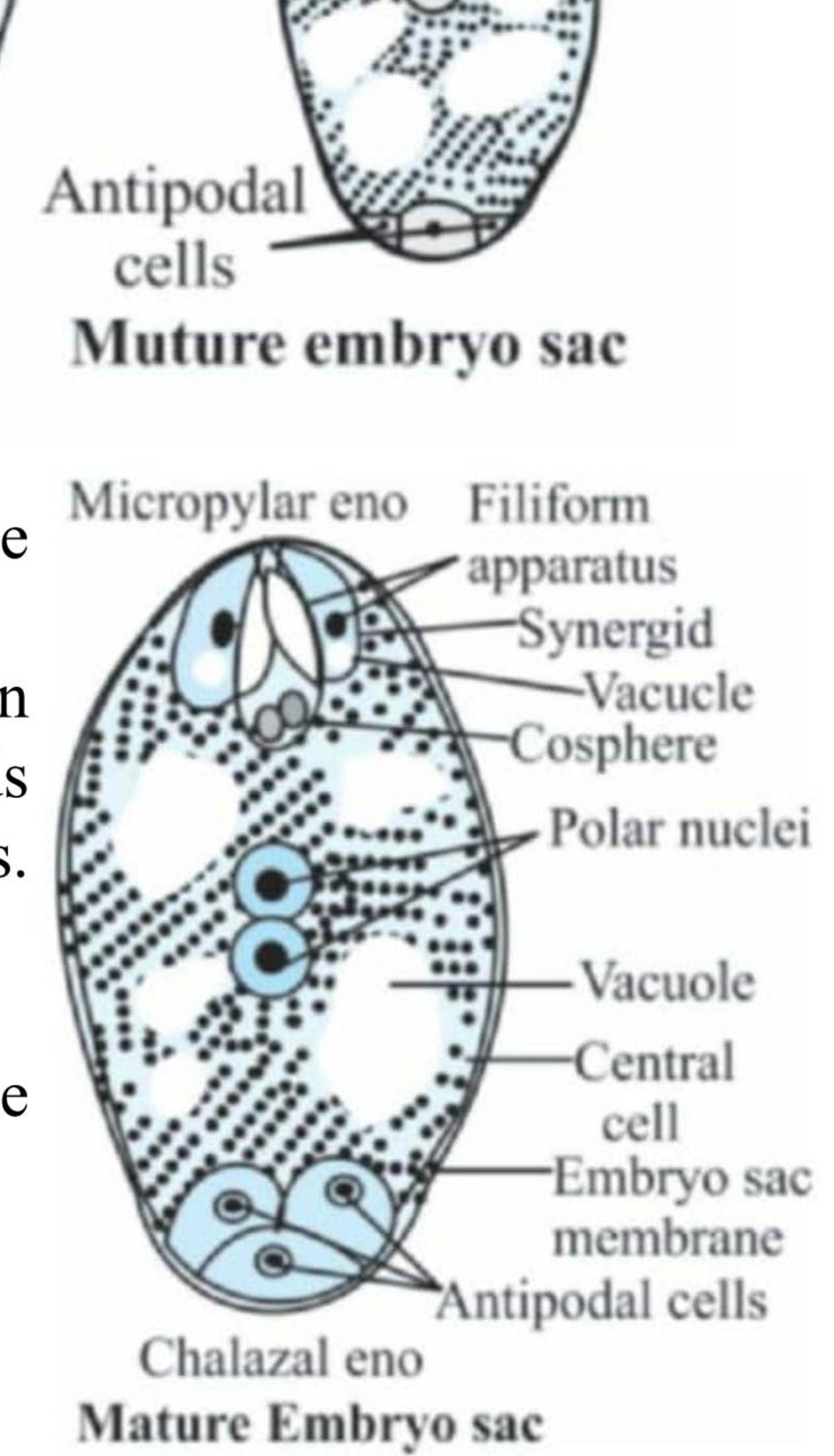
Synergids have special cellular finger like thickenings at the micropylar tip called filiform apparatus.

Filiform apparatus play an important role in guiding the pollen tubes into the synergids. Synergids help pollen tube grow towards egg apparatus by secreting chemotropically active substances. Central cell consists of two polar nuclei. Central cell is diploid.

Types of Embryo sac

- (i) Monosporic embryo sac:** Embryo sac developed from one megasporangium. They are of 2 types

- Polygonum type : It is eight nucleated and seven celled

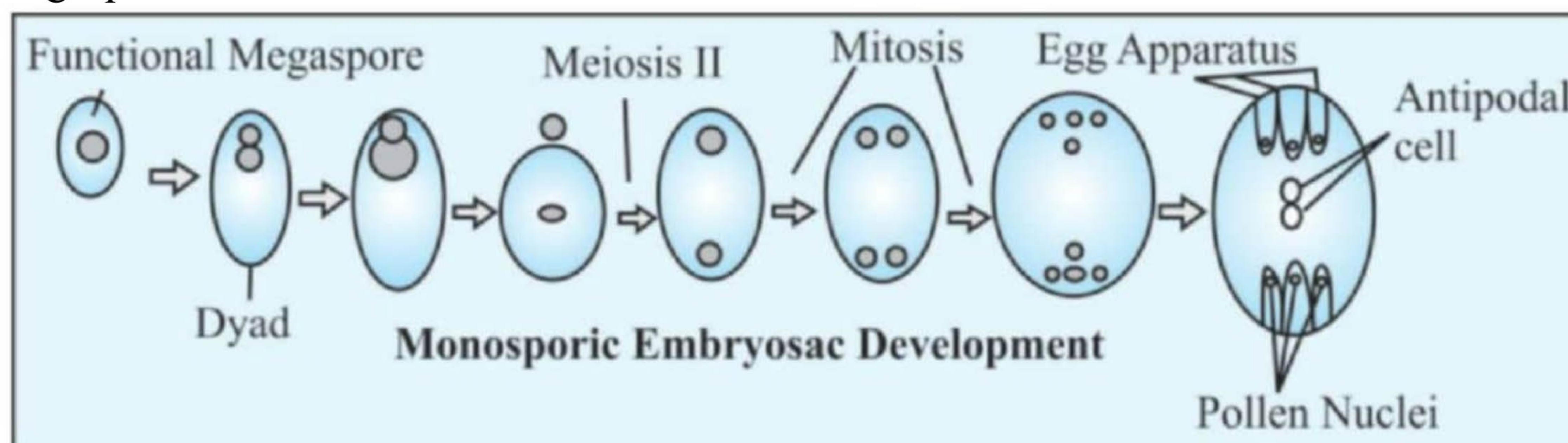


The functional megaspore develops into female gametophyte.

Megaspore is the initial cell of female gametophyte or embryosac. The nucleus of functional megaspore divides mitotically to form two nuclei which move to the opposite poles. Two more sequential mitotic nuclear division result in the formation of the four nucleate and later eight nucleate stages. Interestingly mitotic division are free nuclear and are not followed by cytokinesis. Cytokinesis takes place at 8-nucleate stage, leading in cell wall formation. Six of the eight nuclei are surrounded by cell walls and organised into cells, remaining 2 nuclei are placed in the centre. Three cells are grouped together at micropylar end and constitute the egg apparatus. Egg apparatus consists of 2 synergids and one egg cell. Three cells are grouped together at chalazal end and are called antipodals. The large central cell has two polar nuclei. Hence the typical angiospermic embryosac is a 8 nucleate 7 celled.

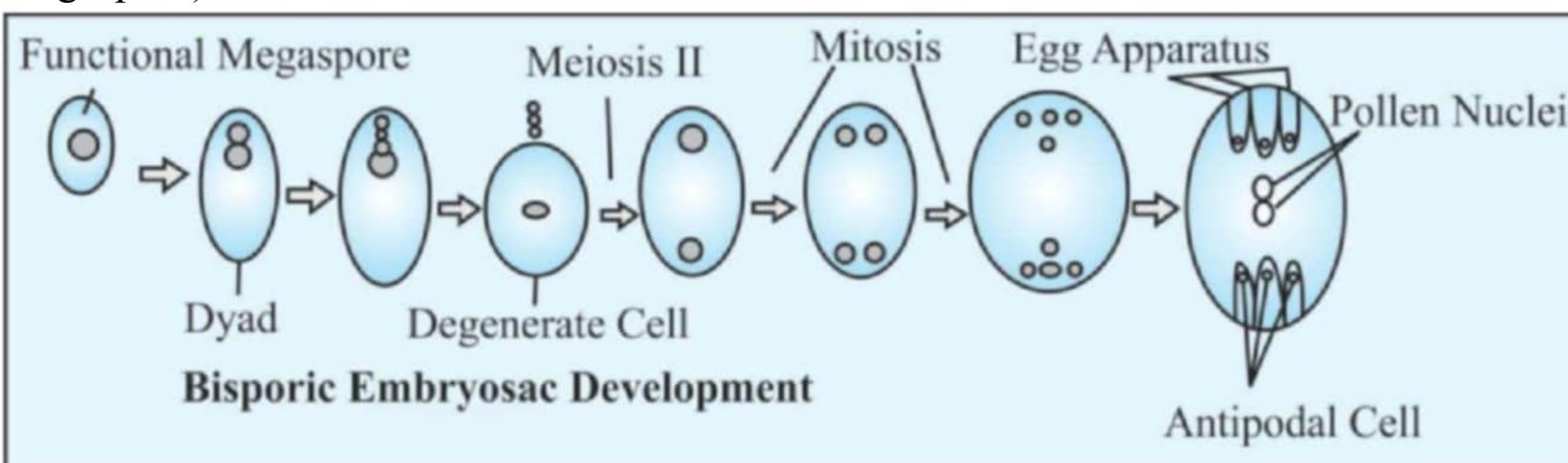
embryo sac (develops from chalazal end)

- (b) Oenothera type : It is 4 nucleated where antipodal cells are absent. One nucleus is present in central cell, three nucleus in the egg apparatus. Embryo sac develops from micropylar megasporangium.

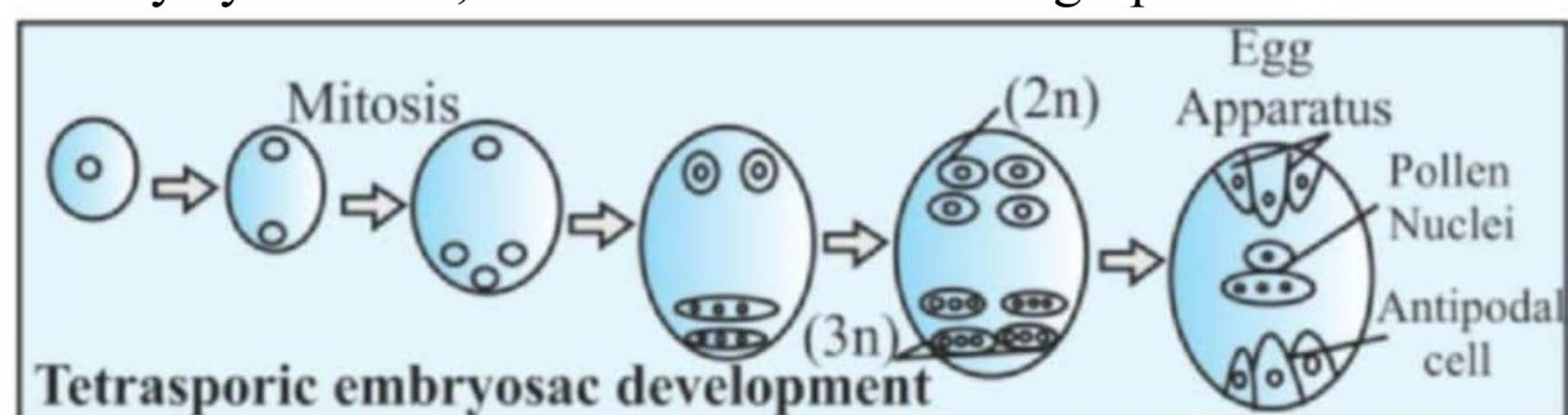


(ii) **Bisporic embryo sac** : It is formed by two megasporangia.

- (a) Allium type : Eight nucleated and seven celled embryosac (develops from chalazal megasporangium)
 (b) Endymion type: Eight nucleated and seven celled embryosac (develops from micropylar megasporangium)



(iii) **Tetrasporic Embryo sac** : It is formed by all four megasporangium nuclei because meiosis is not accompanied by cytokinesis, so that four nuclei of megasporangium are formed.



Pollination

The transfer of pollen grains from anther to the stigma is called pollination. Process of pollination occurs before fertilization.

Self Pollination

It is the transfer of the pollen grain from anther of the flower to stigma of the same flower or genetically similar flower

Homogamy: Condition in which male and female reproductive parts of a bisexual flower mature at the same time.

Bisexuality : It corresponds to occurrence of both male and female sex organs in a flower. Eg: Hibiscus

AGENTS OF POLLINATION

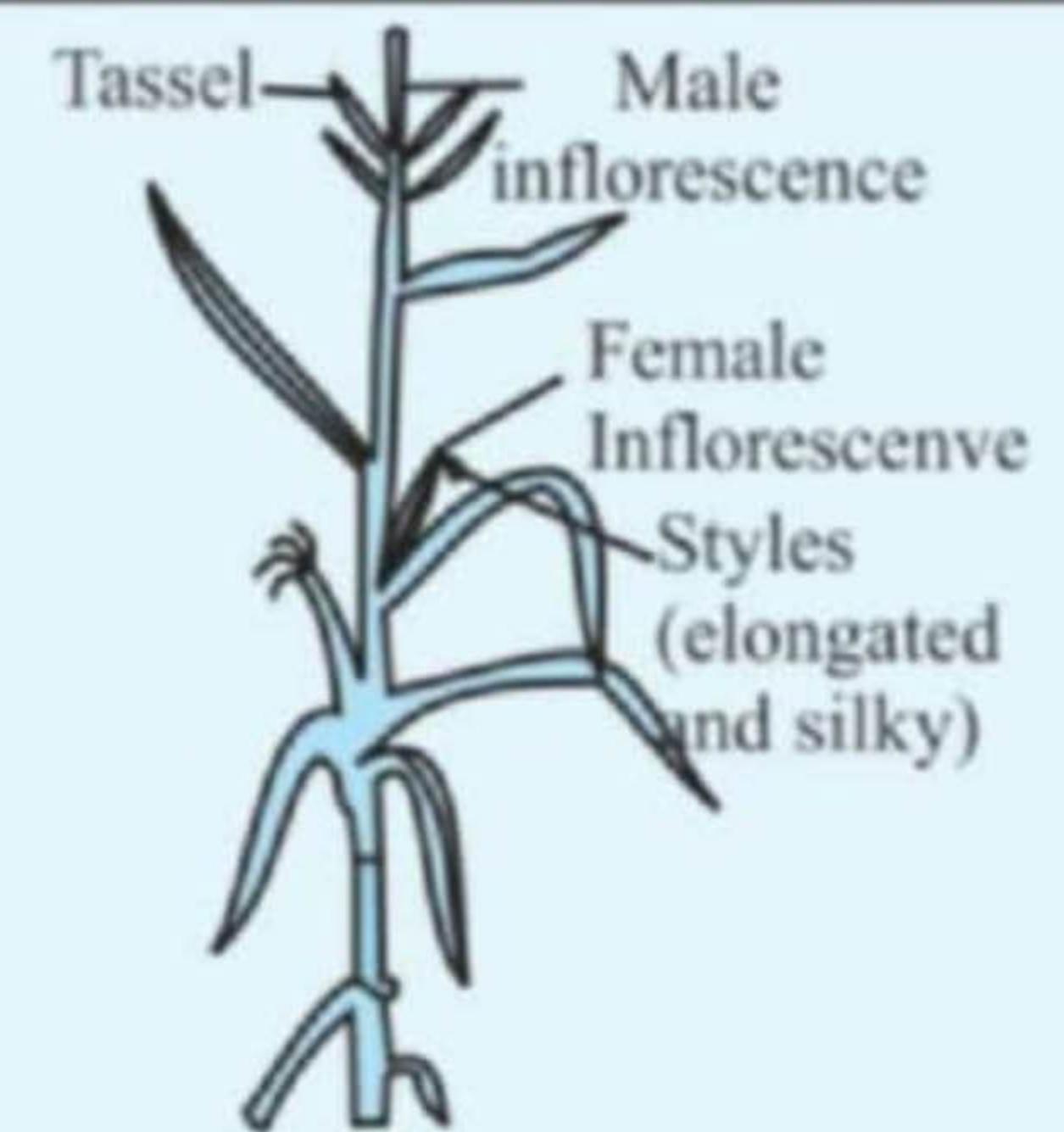
Anemophily

Pollination taking place by means of wind.

Ex: Grasses, Maize, Sugarcane

Characteristic features of wind pollinated flowers:

- Pollen grains are light, small sized, non-sticky and powdery.
- Stigma is large & feathery to trap pollen grains
- They have single ovule in each ovary and numerous flowers packed into an inflorescence.
- Flowers are devoid of scent

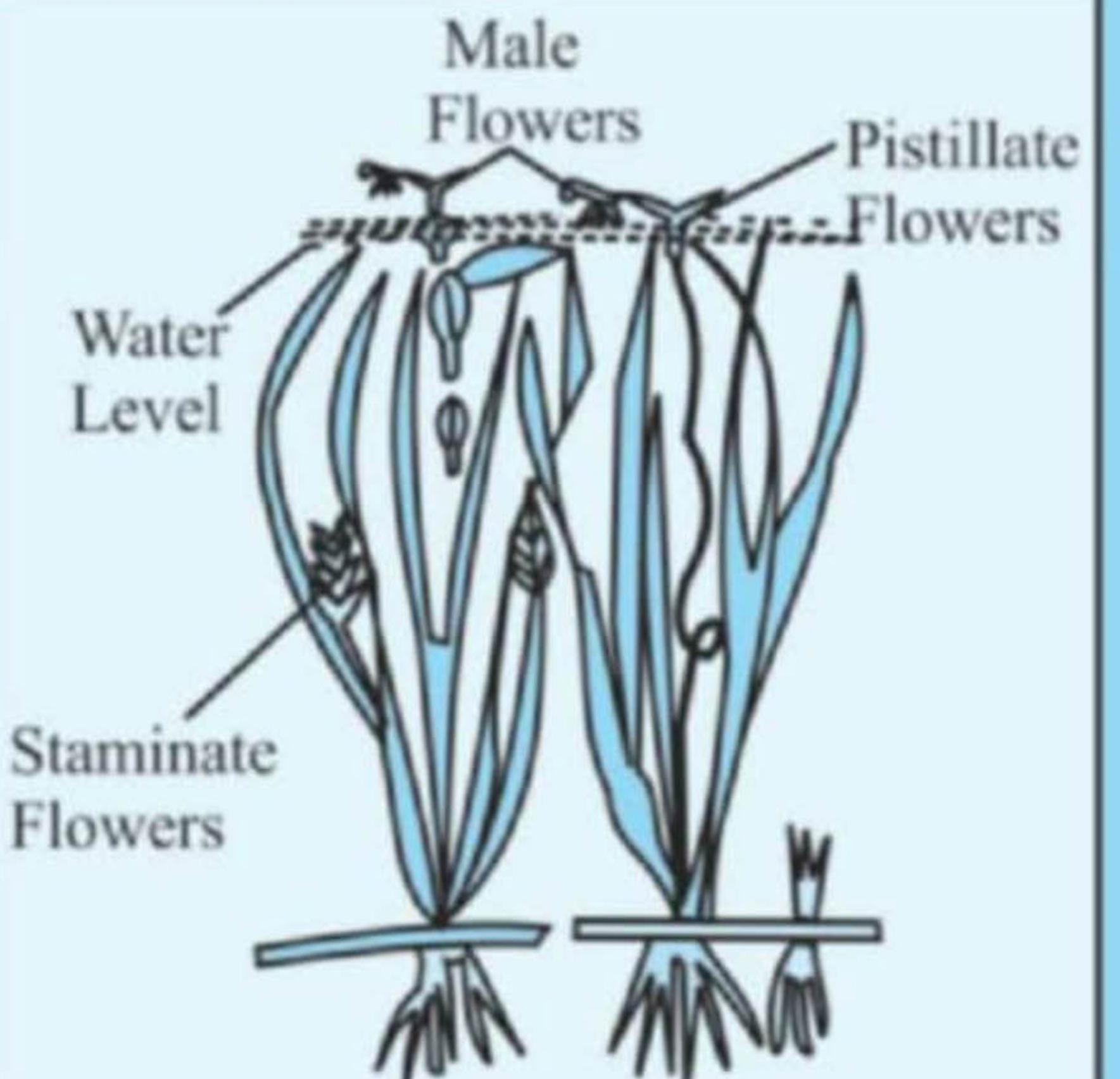


Hydrophily

Pollination taking through water Ex: Some of the hydrophytes

Characteristic feature of water pollinated flowers:

- Pollen grains are long and ribbon like
- Pollen grains are protected from wetting by mucilaginous covering.
- Types of Hydrophily**
 - Hypohydrophily- It occurs below the surface of water. Ex: *Zoster*
 - Epiphydrophily- It occurs above the surface of water. Ex: *Vallisneria*

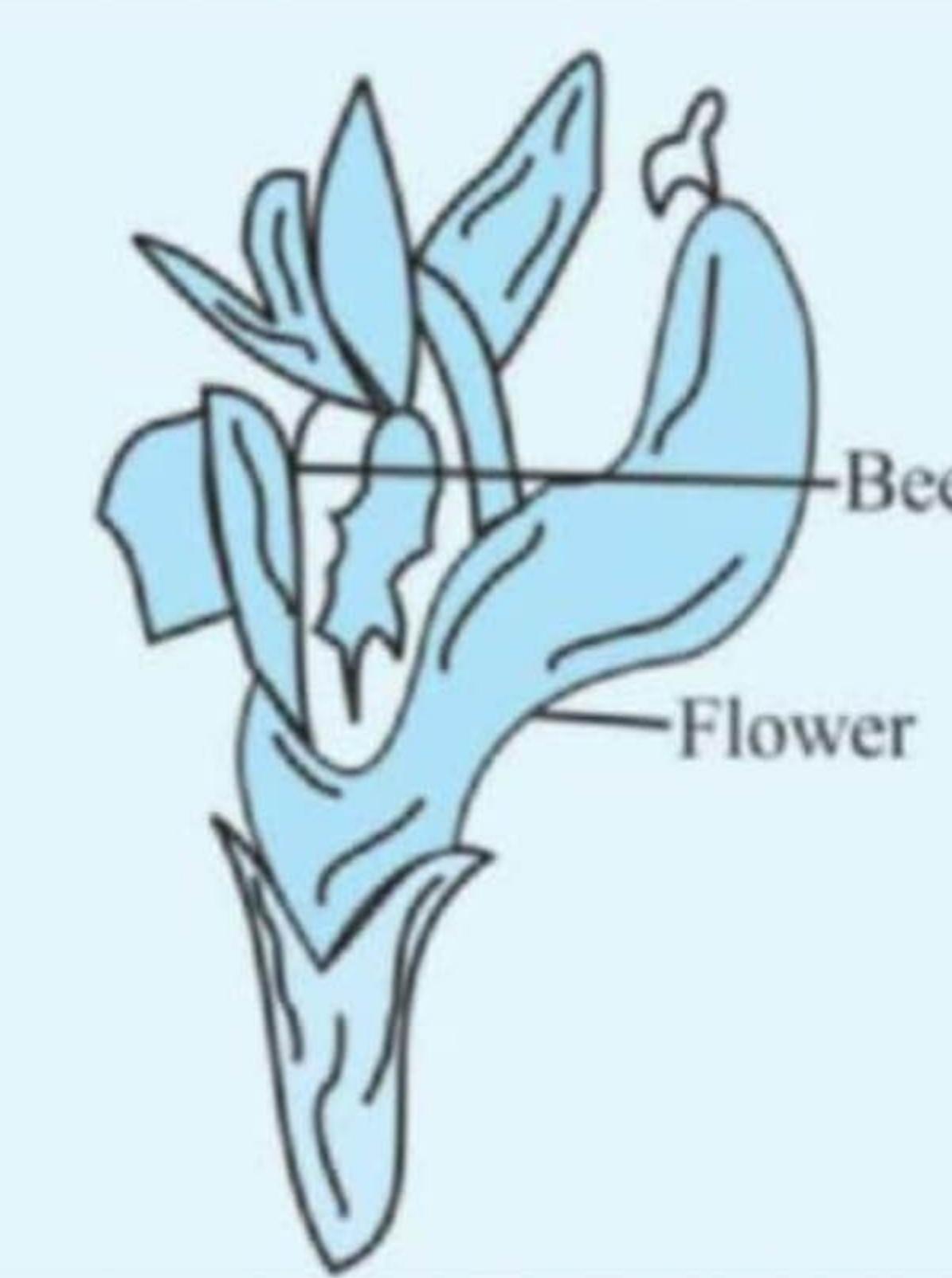


Entomophily

Pollination which takes place through insects. Ex: *Clementis*

Characteristic feature of insect pollinated flowers:

- Large, Colourful, Showy, fragrant, rich in nectar
- Provide reward in the form of nectar and pollen
- Safe place to lay eggs
- Some flowers produce foul odour to attract flies and beetles
- Pollen grains are sticky



Chiropterophily

Pollination which takes place through bats. It is common in night blooming plants.

Ex: *Adansonia*



Therophily-Pollination taking place through squirrels, rodents Ex: Proteaceae members

Ophiophily-Pollination taking place through snakes. Ex: *Michelia, Santalum*

Malacophily-Pollination taking place through snails. Ex: *Arisaema*

Abiotic agents

Biotic agents

Autogamy : Transfer of pollen to stigma takes place in same flower Eg: Rice. Bending of style and filament of 2 organs happens.

Geitonogamy: Transfer of pollen grains from stamen to stigma of different flower of same plant

Cross Pollination

Transfer of pollen grain from anther of the flower to the stigma of different flower of another plant (**Xenogamy**)

Dichogamy: condition where male and female sex organs of a flower mature at different times.

Protandry - when anthers mature earlier than gynoecium, e.g., *Helianthus, Tagetes*.

Protogyny - when gynoecium matures earlier than the anther, e.g., *Gloriosa, Plantago*

Self incompatibility: It refers to failure of pollen to germinate on the stigma of same flower due to physiological or genetic reasons, e.g., tobacco.

Herkogamy: It is the presence of natural or physical barriers between androecium and gynoecium of a bisexual flower e.g., in *Calotropis*, pollen grains occur in pollinia which can be lifted by insects only

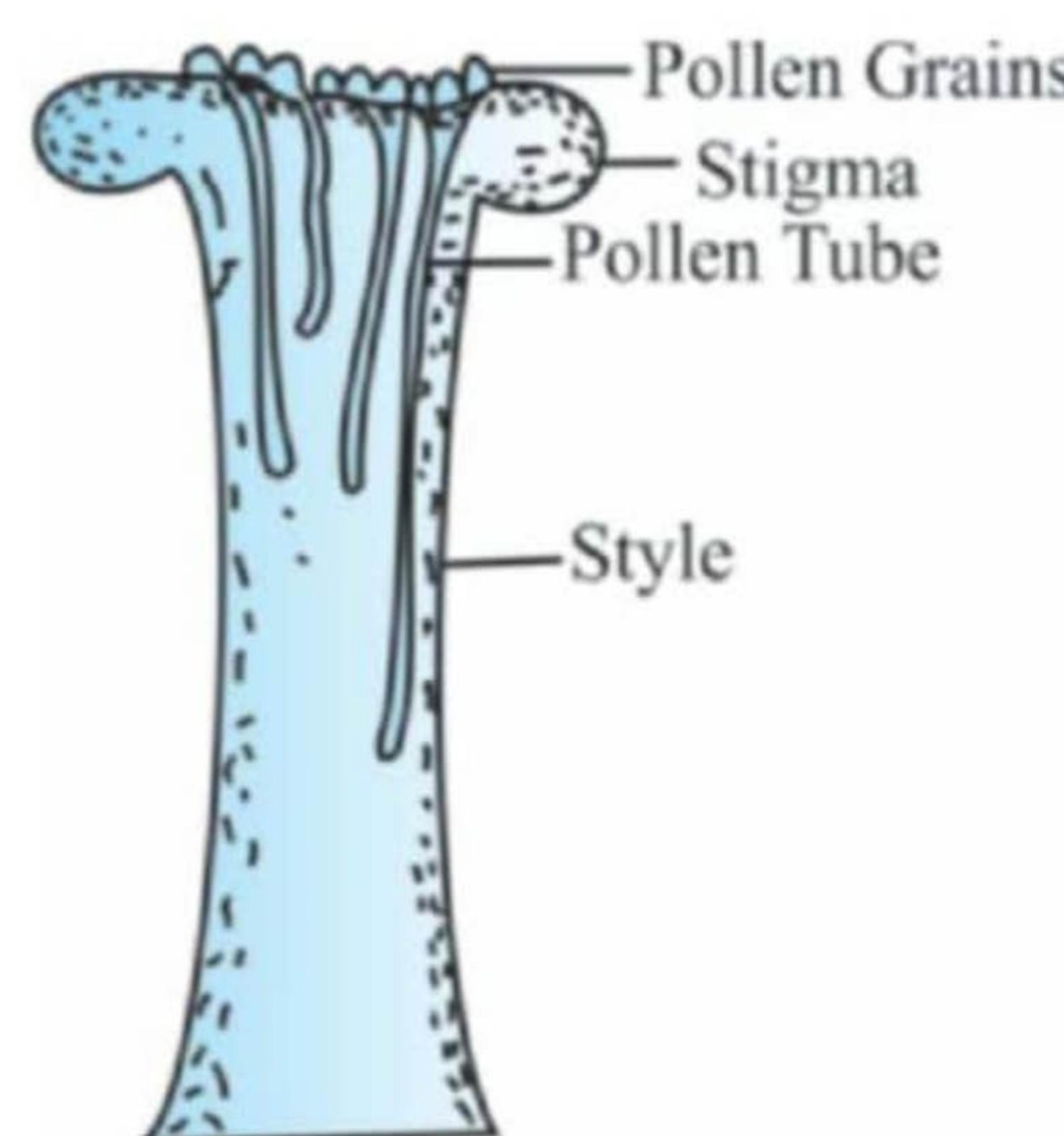
Heterostyly: Occurrence of two or more types of flower with regard to length of style and stamens viz. pin eyed (short stamen and long style), thrum eyed (long stamen and short style), e.g., *Primula*

Pollen – Pistil Interaction

Pollen grains of a number of plants may settle over a stigma. Only the right pollen belonging to same species would germinate while other fail to do so. Compatibility and

Incompatibility is determined by special proteins. Compatible pollen germinate and produce pollen tubes. If the pollen is of wrong type, the pistil rejects the pollen by preventing pollen germination on the stigma or pollen tube growth on the style. The ability of the pistil to recognize the pollen followed by its acceptance or rejection is the result of a continuous dialogue between pollen grain and pistil. This dialogue is mediated by chemical components of the pollen interacting with those of the pistil. All the events from pollen deposition on the stigma to the entry of pollen tube into ovule are together referred as pollen pistil interaction.

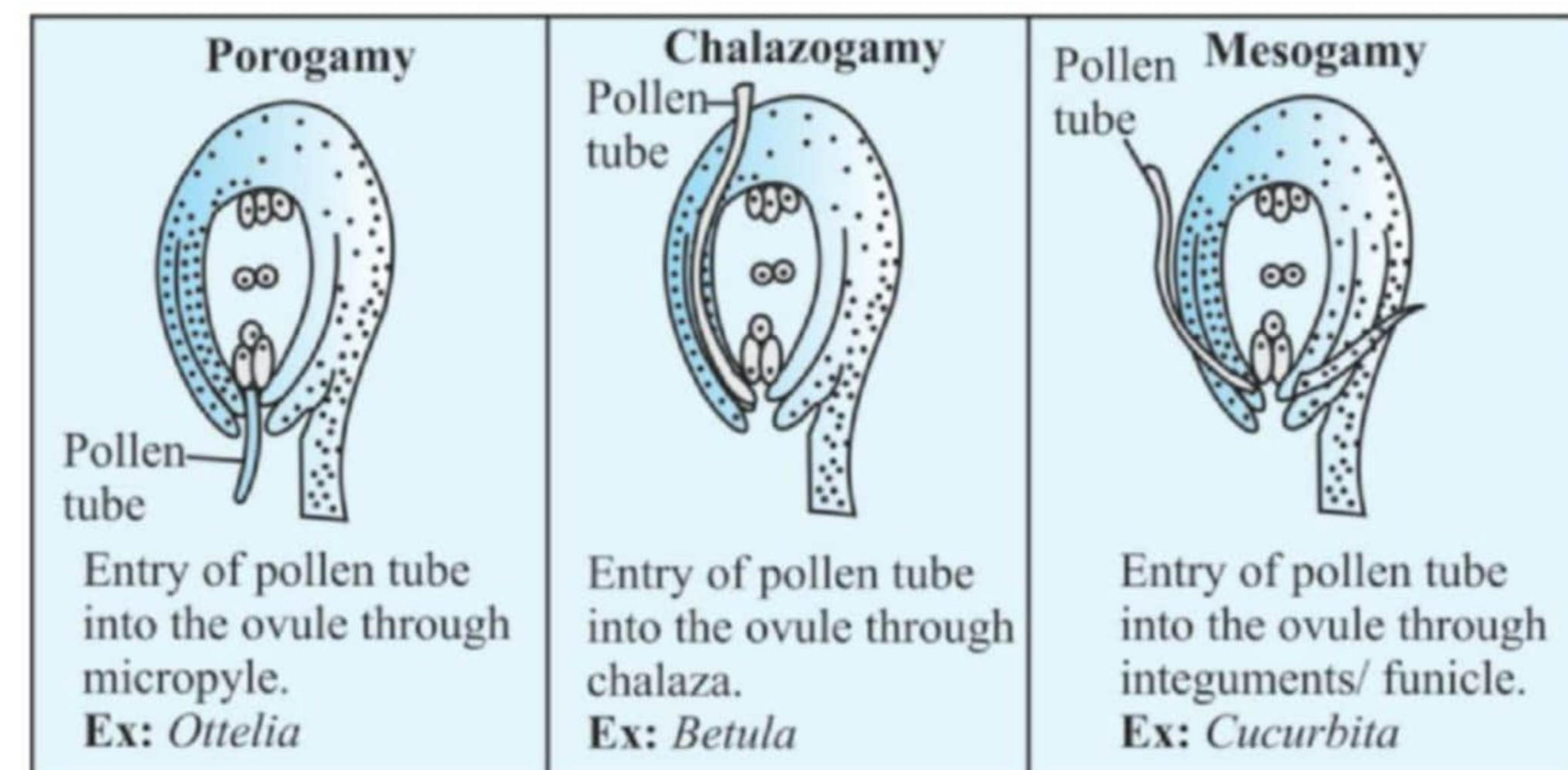
Pollen germination



Pollen grain after falling on stigma, start germination in the presence of moisture and nutrients available on stigma. Pollen tube emerge from the intine of the pollen grain. It produces enzymes which digest the tissues of the stigma and style. Usually pollen grains are monosiphonous (one pollen tube arise from one pollen grain). Some time it may be Polysiphonous (more than one pollen tube arise from one pollen grain).

Entry of Pollen Tube into Ovule

Entry of pollen tube in the ovule is either of the three ways.



Fertilization

- Pollen tube enters the tip of the filiform apparatus and enters the cytoplasm of one of the synergids.
- Pollen tube contents gets released into the synergids and tube does not grow beyond it in embryo sac.
- Tip of the pollen tube bursts releasing two male gametes and large amount of cytoplasm.

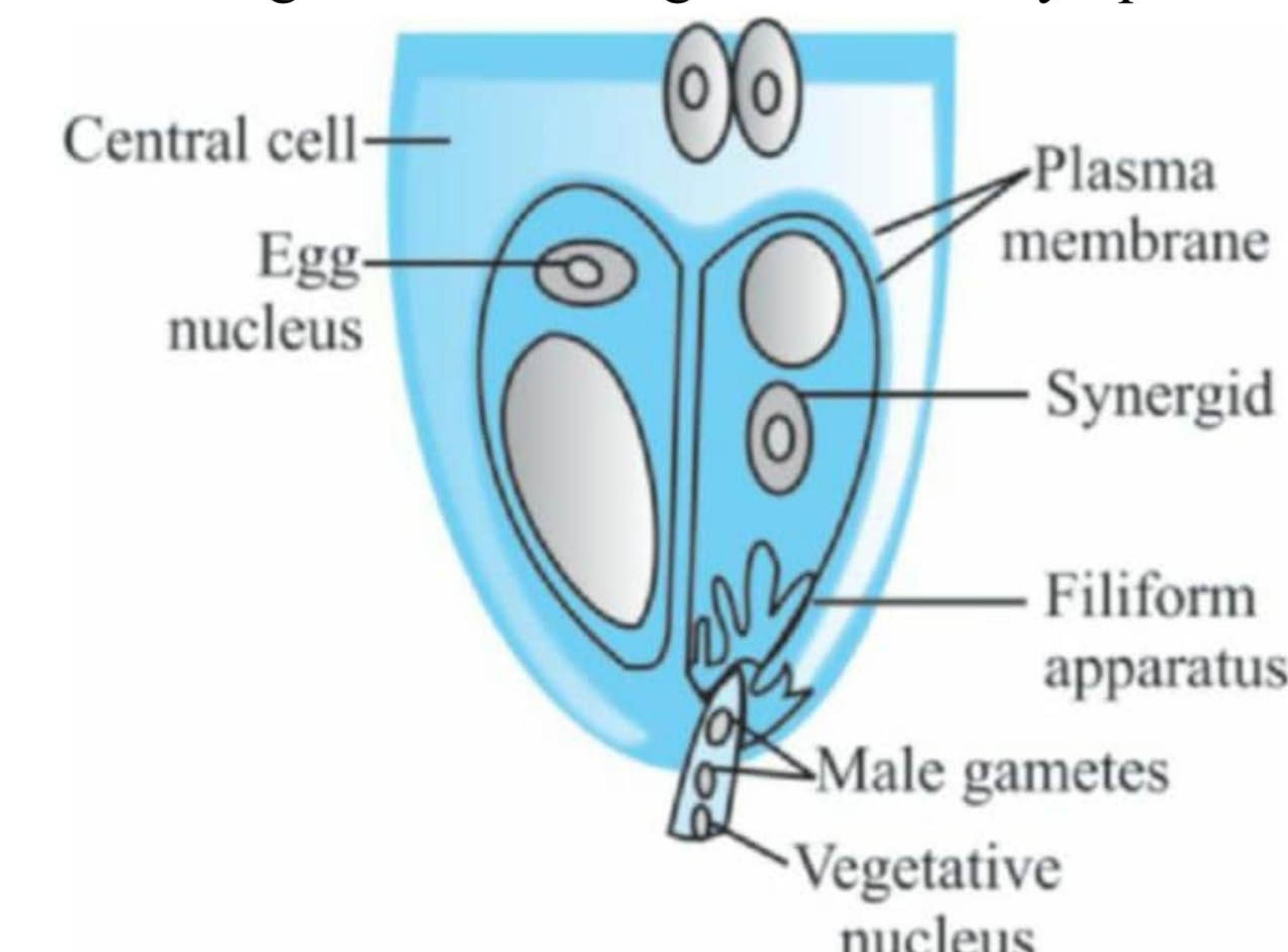
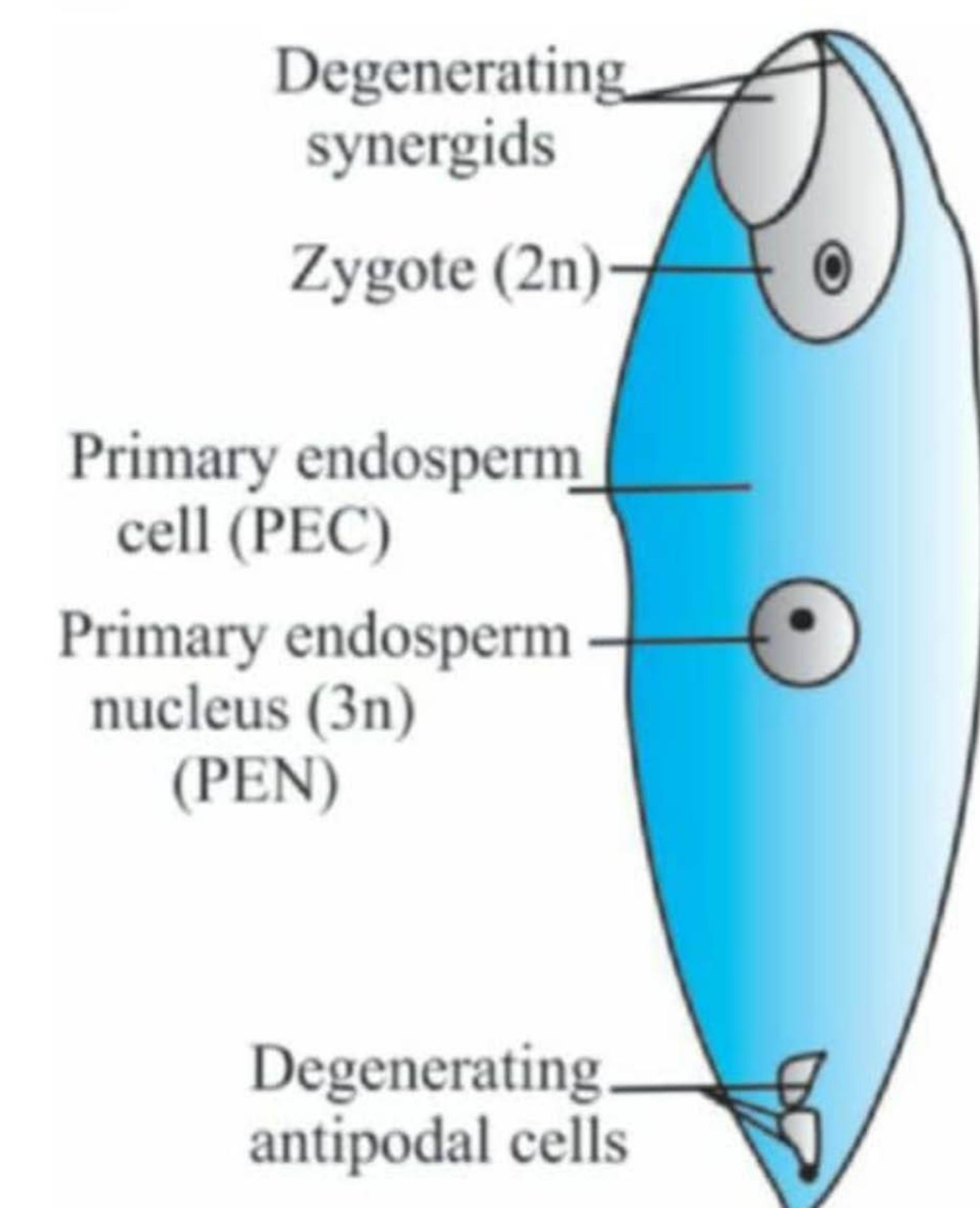


Fig: Entry of pollen tube in embryo sac

- One male gamete fuses with the egg to form zygote (2n). This is called as Syngamy or generative fertilization. It was discovered by Strasburger.
- Second male gamete fuses with two polar nuclei or secondary nucleus of central cell to form triploid primary endosperm nucleus (PEN). This is known as triple fusion. It was discovered by Nawaschin.



- Central cell after triple fusion becomes Primary endosperm cell (PEC).
- Occurrence of syngamy and triple fusion simultaneously in the embryo sac of the angiosperms is called as Double fertilization (discovered by S.G. Nawaschin).
- Zygote develops into embryo and Primary endosperm cell becomes Endosperm.

MULTIPLE CHOICE QUESTIONS

- The microspore tetrad of angiosperm at the time of formation, are surrounded by a callose wall. Breakdown of this wall is brought about by the enzyme callase synthesized by the

- (a) Tetrad cytoplasm
 (b) Ribosome of the tetrad
 (c) Spore mother cells
 (d) Cells of tapetum
- 2.** Siphonogamy in angiosperm means
 (a) Tube like male gametes
 (b) Motile male gametes
 (c) Male gametes produced in a tube
 (d) Male gametes are carried in a tube
- 3.** If the diploid number of an angiospermic plant is 24, the number of chromosomes in the pollen grain, endosperm and integument will be
 (a) 12, 36, 24 (b) 12, 24, 36
 (c) 12, 12, 36 (d) 12, 36, 12
- 4.** The endosperm found in angiospermic seed is different from that of gymnosperms in the sense that, in the former
 (a) It is formed before fertilization while in the latter it is formed after fertilization
 (b) It is formed after fertilization while in the latter it is formed before fertilization
 (c) It is cellular while in the latter it is nuclear
 (d) It is nutritive while in the latter it is protective
- 5.** After penetrating stigmatic and style tissues, the pollen tube usually grow down towards the egg because
 (a) The egg cell attracts the pollen tube as they have dissimilar electric charge
 (b) The filiform apparatus of synergids is believed to attract the pollen tube
 (c) It has no other passage to follow
 (d) It grows under control of nucleus
- 6.** Which of the following statement is correct for the pollen tube
 (a) It shows chemotactic movement
 (b) It shows only tip growth

- (c) It is composed of three non-cellular zones
 (d) It shows radial cytoplasmic streaming
- 7.** A particular species of plant produces light, non sticky pollen in large numbers and its stigma are long and feathery. These modifications facilitate pollination by
 (a) Insects (b) Wind
 (c) Water (d) Animals
- 8.** Which of the following statement is true?
 (i) Pollen release and stigma receptivity are always synchronized in all species.
 (ii) Pollination does not guarantee the transfer of right type of pollen.
 (iii) Micropyle represents the basal part of ovule.
 (iv) Most zygotes divide only after certain amount of endosperm is formed.
 (a) i, iii (b) i, ii, iv
 (c) ii, iv (d) ii, iii, Iv
- 9.** Which of the following nucleus is unlike other nuclei in the female gametophyte of angiosperms?
 (a) Nucleus of antipodal
 (b) Nucleus of synergids
 (c) Secondary nucleus
 (d) None of the above
- 10.** In a flower, if megasporangium forms megasporangium without undergoing meiosis and if one of them megasporangium develops into an embryo sac, its nuclei would be
 (a) Haploid
 (b) Diploid
 (c) A few haploid and a few diploid
 (d) With varying ploidy
- 11.** What is the correct sequence of the formation of female gametophyte in angiosperms?
 (a) Nucellus, megasporangium, megasporangium, megasporangium, female gametophyte

- (b) Megasporangium, nucellus, megasporangium, megasporangium, female gametophyte
- (c) Nucellus, megasporangium, megasporangium, megasporangium, female gametophyte
- (d) Megasporangium, megasporangium, megasporangium, megasporangium, female gametophyte
- 12.** Which one of the following statements is correct?
 (a) Cleistogamous flowers are always autogamous.
 (b) Xenogamy occurs only by wind pollination
 (c) Chasmogamous flowers do not open at all
 (d) Geitonogamy involves the pollen and stigma of flowers of different plants
- 13.** Primary endosperm nucleus (PEN) is formed by the fusion of
 (a) 2 polar nuclei + 1 synergid cell nucleus
 (b) 1 polar nucleus + 1 antipodal cell nucleus + 1 synergid cell nucleus
 (c) 2 polar nuclei + 1 male gamete nucleus
 (d) 2 antipodal cell nuclei + 1 male gamete nucleus
- 14.** Which one of the following statements is correct?
 (a) Endothecium produces the microspores
 (b) Tapetum nourishes the developing pollen
 (c) Hard outer layer of pollen is called intine
 (d) Sporogenous tissue is haploid
- 15.** What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids?
 (a) 16 (b) 24 (c) 32 (d) 8
- 16.** Match the following
- | Column I | Column II |
|-----------------|----------------------------|
| A. Funicle | (i) Small opening in ovule |

PREVIOUS YEAR NEET QUESTIONS

21. What type of pollination takes place in *Vallisneria*? **(NEET 2019, Odisha)**

- (a) Pollination occurs in submerged condition by water
- (b) Flowers emerge above surface of water, and pollination occurs by insects
- (c) Flowers emerge above water surface, and pollen is carried by wind.
- (d) Male flowers are carried by water currents to female flowers at surface of water.

22. Which one of the following statements regarding post-fertilization development in flowering plants is incorrect? **(NEET 2019)**

- (a) Ovary develops into fruit
- (b) Zygote develops into embryo
- (c) Central cell develops into endosperm
- (d) Ovules develop into embryo sac

23. What is the fate of the male gametes discharged in the synergid? **(NEET 2019)**

- (a) One fuses with the egg, other(s) degenerate(s) in the synergid.
- (b) All fuse with the egg
- (c) One fuses with the egg, other(s) fuse with synergid nucleus.
- (d) One fuses with the egg and other fuses with central cell nuclei

24. Double fertilization is **(NEET 2018)**

- (a) Fusion of two male gametes of a pollen tube with two different eggs
- (b) Fusion of one male gamete with two polar nuclei
- (c) Fusion of two male gametes with one egg
- (d) Syngamy and triple fusion

25. A dioecious flowering plant prevents both: **(NEET 2017)**

- (a) Autogamy and geitonogamy
- (b) Geitonogamy and xenogamy

- (c) Cleistogamy and xenogamy
- (d) Autogamy and xenogamy

ANSWER KEY

- | | | | | |
|--------------|--------------|--------------|--------------|--------------|
| 1. d | 2. d | 3. a | 4. b | 5. b |
| 6. a | 7. b | 8. c | 9. c | 10. b |
| 11. c | 12. a | 13. c | 14. b | 15. b |
| 16. a | 17. c | 18. b | 19. c | 20. a |
| 21. d | 22. d | 23. d | 24. d | 25. a |

HINTS & SOLUTIONS

1. (d) Callose is a layer which is around the tetrads. Enzyme released from tapetum called callase will dissolve the callose and microspores will get separated.

2. (d) In angiosperms, pollen tube will carry 2 male gametes from stigma till embryo sac. This is called as Siphonogamy.

3. (a) Pollen grains, endosperm in angiosperm and integuments are always haploid, triploid and diploid respectively. In a diploid plant with chromosome number 24, pollen grains, endosperm and integuments will have 12, 36, 24 chromosomes respectively.

4. (b) In angiosperm there is triple fusion hence there is formation of triploid endosperm. In Gymnosperm there is no double fertilization, hence the endosperm is diploid.

5. (b) In the embryosac there is filiform apparatus which will attract pollen tube towards the synergids.

6. (a) Growth of pollen tube is said to be chemotactic movement as in the presence of chemicals like calcium- boron they will grow.

7. (b) Anemophilous flowers have light, non-sticky pollen in large numbers and its stigma are long and feathery.

8. (c) Pollen release and stigma receptivity should be synchronised so that self pollination takes place. But some flowers support cross pollination, in which pollen release and stigma receptivity will not be synchronised. Basal part of ovule is chalaza.

9. (c) Secondary nucleus are the nucleus present in the central cell of embryo sac.

10. (b) If megasporangium undergoes meiosis then the nucleus of the embryo sac will be haploid. But if megasporangium undergoes meiosis then the nucleus of the embryo sac will be diploid.

11. (c) Hypodermal region of nucellus develops an archesporial cell. Archesporial cell divides periclinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megasporangium (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megasporangia. Among 4 megasporangia, three will degenerate and one will remain functional. Functional megasporangium will develop into female gametophyte.

12. (a) Cleistogamous flowers are unopened flowers hence there is no chance of cross pollination and they always undergo self pollination.

13. (c) During triple fusion, one male gamete fuses with secondary nucleus and hence forms triploid primary endosperm nucleus (PEN).

14. (b) Tapetum is nutritious tissue which provides nourishment for the growing pollen grains.

15. (b) Synergids are haploid and aleurone layer is triploid. If synergids are having 8 chromosomes then aleurone layers will have 24 chromosomes.

16. (a) Funicle is the stalk of the ovule. The point of attachment of the body of ovule with funicle is called Hilum. Basal part of Ovule is chalaza. Ovule is covered by integuments and

small opening in ovule where integuments are not covered is called as micropyle.

17. (c) Exine has apertures called germpores. Germpores do not have sporopollenin.

18. (b) Pollen mother cell (PMC) undergoes one meiotic and two mitotic divisions to form mature gametophyte.

19. (c) Pollen grains are usually shed at 2-celled stage but in some plants it sheds at 3-celled stage also.

20. (a) Microspore mother cell is a diploid and endosperm in angiosperm is triploid. If the number of chromosomes in the microspore mother cell is 24, then the chromosomes in endosperm will be 36.

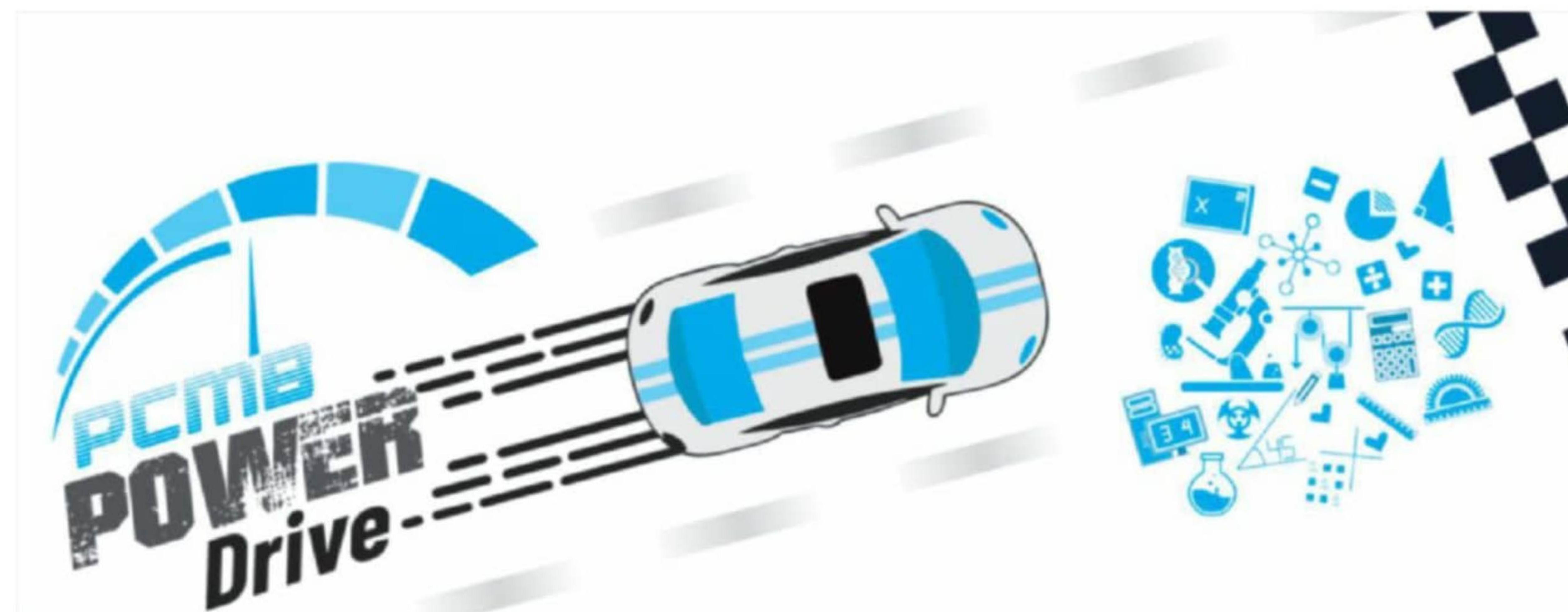
21. (d) *Vallisneria* undergoes epiphydrophily, where male gametes are carried by water currents to female flowers at surface of water.

22. (d) Embryo sac is present inside the ovule. Hypodermal region of nucellus develops an archesporial cell. Archesporial cell divides periclinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megasporangium (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megasporangia. Among 4 megasporangia, three will degenerate and one will remain functional. Functional megasporangium will develop into female gametophyte.

23. (d) Pollen tube bursts in the synergid and male gametes are discharged in it. In it one male gamete fuses with the egg and other gamete uses with central cell nuclei.

24. (d) Double fertilization is fusion of male gamete and female gamete (syngamy) as well as fusion of secondary nucleus with male gamete (triple fusion).

25. (a) When the male and female flowers occur on separate plants the condition is called *dioecious* and it prevents both autogamy and geitonogamy.



BREATHING AND EXCHANGE OF GASES

By: Murali Krishna (Hyderabad)

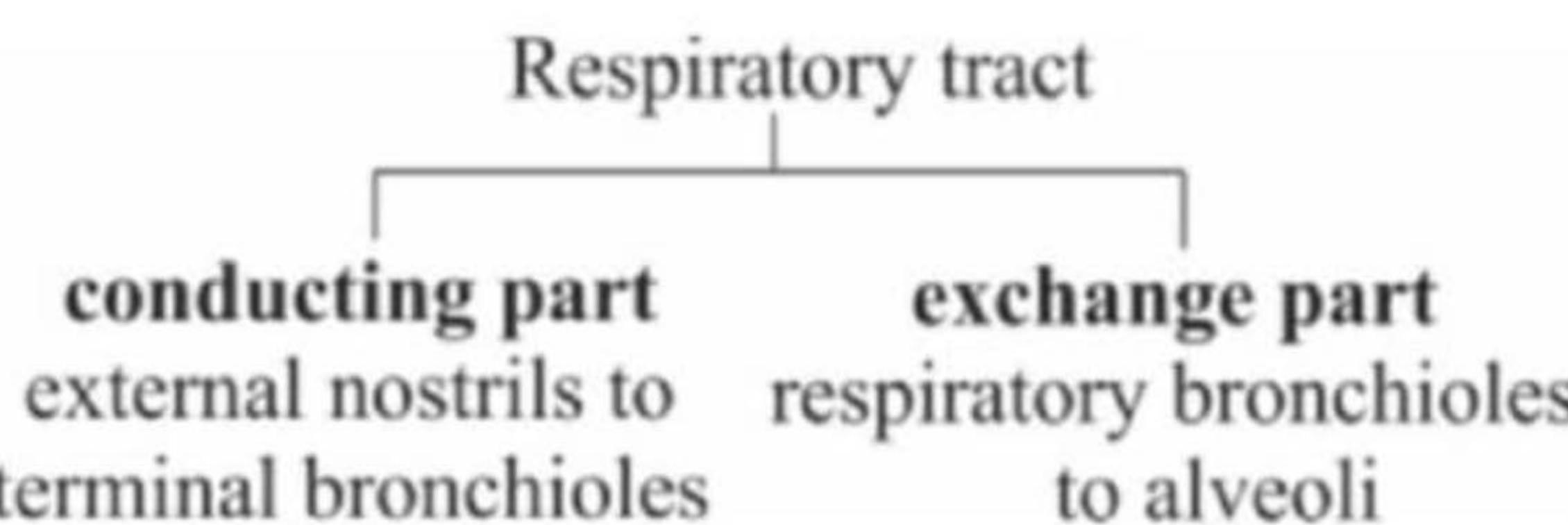
Human Respiratory System

- External nostrils → nasal chamber → pharynx → larynx → trachea.
- A portion of pharynx is the common passage for food and air.
- Larynx is a cartilaginous box which helps in sound production (sound box).
- During swallowing glottis can be covered by a thin elastic cartilaginous flap called epiglottis to prevent the entry of food into the larynx.
- Trachea divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
- Trachea → primary bronchi → secondary bronchi → tertiary bronchi → primary bronchioles → secondary bronchioles → tertiary bronchioles → terminal bronchioles → alveolar ducts → alveoli.
- The tracheae, primary, secondary and tertiary bronchi, and initial bronchioles are supported by incomplete cartilaginous rings made up of hyaline cartilage.
- The branching network of bronchi, bronchioles and alveoli comprise the lungs.
- Lungs are covered by a double layered pleura.
- The outer parietal pleural membrane is in close contact with the thoracic lining whereas the inner visceral pleural membrane is in contact with the lung surface.
- Pleural fluid between the two pleural membranes reduces friction on the lung-surface. It also causes the two membranes to adhere to each other.

Respiratory Organs

- Mechanisms of breathing vary among different groups of animals depending mainly on their habitats and levels of organisation.

Sponges, coelenterates, flatworms	Entire body surface
Earthworms	Moist cuticle
Insects	Tracheal tubes
Most aquatic arthropods and molluscs	Gills (branchial respiration)
Land snails	Lungs (pulmonary sacs)
Fishes	Gills
Amphibians	Larvae: Gills (branchial) Adult: Skin (cutaneous), lungs (pulmonary), buccal cavity (buccal)
Reptiles, birds and mammals	Lungs (pulmonary respiration)



- Functions of the conducting part:*
 - Transports the atmospheric air to the alveoli
 - Clears the air from foreign particles
 - Humidifies the air
 - Brings the air to body temperature.
- Exchange part is the site of actual diffusion of O₂ and CO₂ between blood and atmospheric air.
- The lungs are situated in the thoracic chamber which is anatomically an air-tight chamber.
- The thoracic chamber is formed dorsally by the vertebral column, ventrally by the sternum, laterally by the ribs and on the lower side by the dome-shaped diaphragm.
- The anatomical setup of lungs in thorax is such that any change in the volume of the thoracic cavity will be reflected in the lung (pulmonary) cavity.
- We cannot directly alter the pulmonary volume.

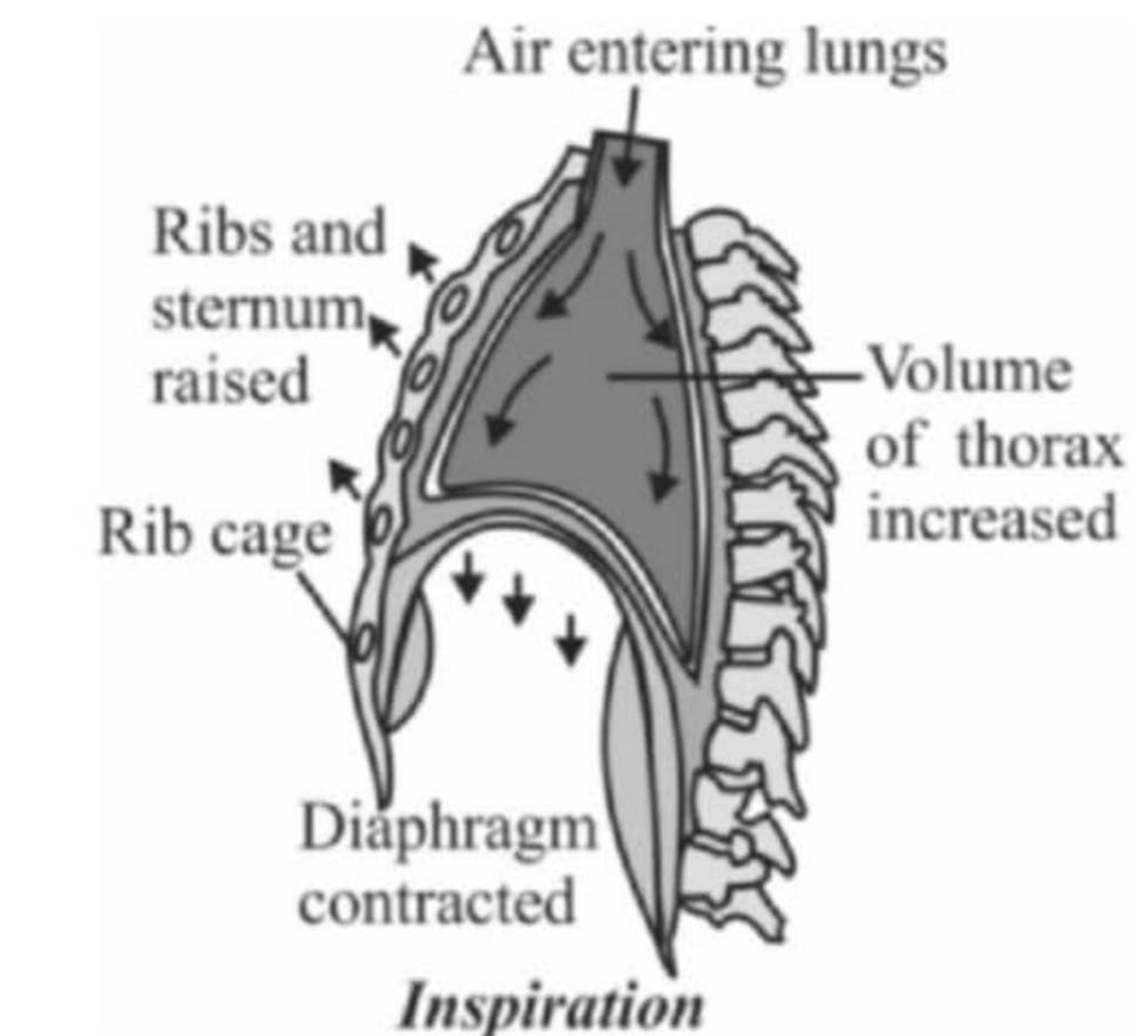
Breathing (pulmonary ventilation)	Atmospheric air is drawn in and CO ₂ -rich alveolar air is released out.
External respiration (pulmonary gas exchange)	Diffusion of O ₂ and CO ₂ across alveolar membrane.
Transport of gases	Transport of gases by the blood.
Internal respiration (systemic gas exchange)	Diffusion of O ₂ and CO ₂ between blood and tissues
Cellular respiration	Utilisation of O ₂ by the cells for catabolic reactions and resultant release of CO ₂

Mechanism of Breathing

- The movement of air into and out of the lungs is carried out by creating a pressure gradient between the lungs and the atmosphere.
- Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure, i.e., there is a *negative pressure* in the lungs with respect to atmospheric pressure.
- Expiration takes place when the intra-pulmonary pressure is higher than the atmospheric pressure.
- The diaphragm and intercostal muscles help in generation of pressure gradients.
- External and internal intercostal muscle extend between the ribs.

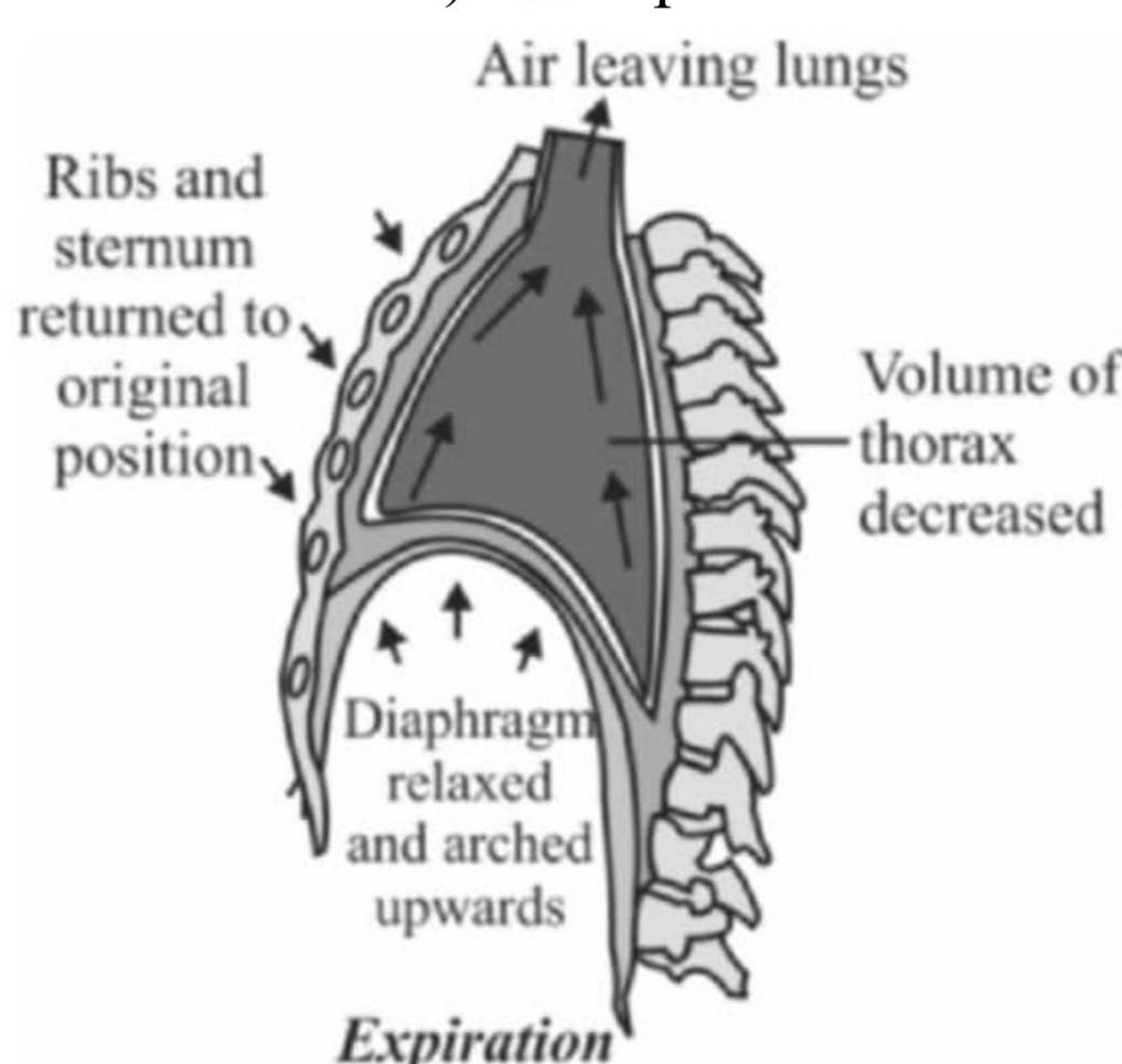
Inpiration

- Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the antero-posterior axis (vertical axis).
- The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis.
- ↑ in the thoracic volume → ↑ in pulmonary volume → ↓ in intra-pulmonary pressure (to <atm. pressure) → inspiration.



Expiration

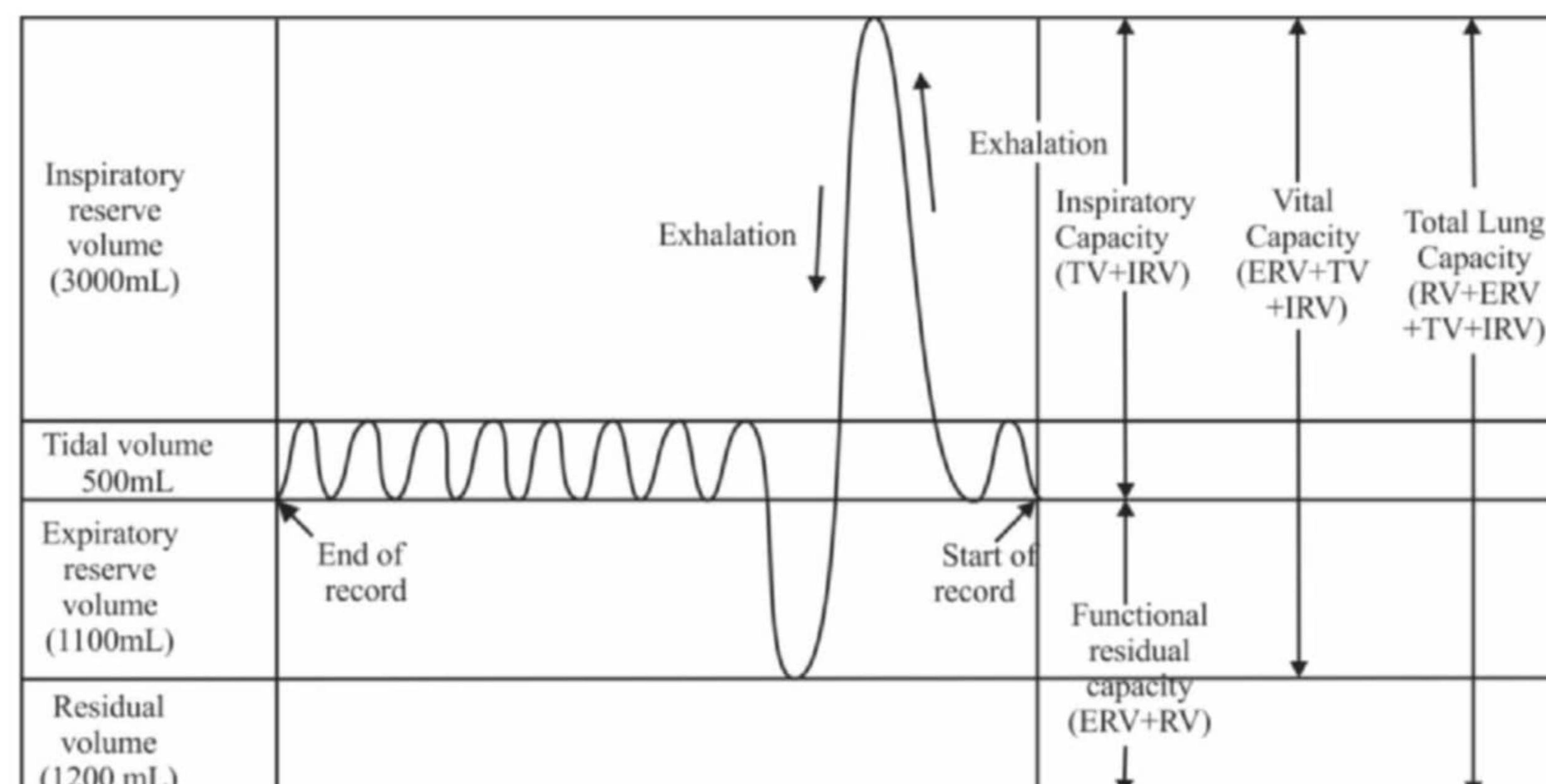
- Relaxation of the diaphragm and the external inter-costal muscles returns the diaphragm and sternum to their normal positions and reduce the thoracic volume and thereby the pulmonary volume (normal expiration).
- \downarrow in thoracic volume \rightarrow \downarrow in pulmonary volume \rightarrow \uparrow in intra-pulmonary pressure (to $>$ atm. Pressure) \rightarrow expiration.



- We have the ability to increase the strength of inspiration and expiration with the help of additional muscles in the abdomen.
- Normal expiration is a passive process (occurs by relaxation of diaphragm and external intercostal muscles) whereas **forced expiration** is an active process (involves contraction of internal intercostal and abdominal muscles).
- On an average, a healthy human breathes 12-16 times/minute.

Lung Volumes and Capacities

- The volume of air involved in breathing movements can be estimated by using a **spirometer** which helps in clinical assessment of pulmonary functions.
- By adding up a few respiratory volumes, one can derive various pulmonary capacities, which can be used in clinical diagnosis.
- Residual volume cannot be measured using normal spirometry (NEET 2017 regional language paper).



Lung Volumes

Spirogram

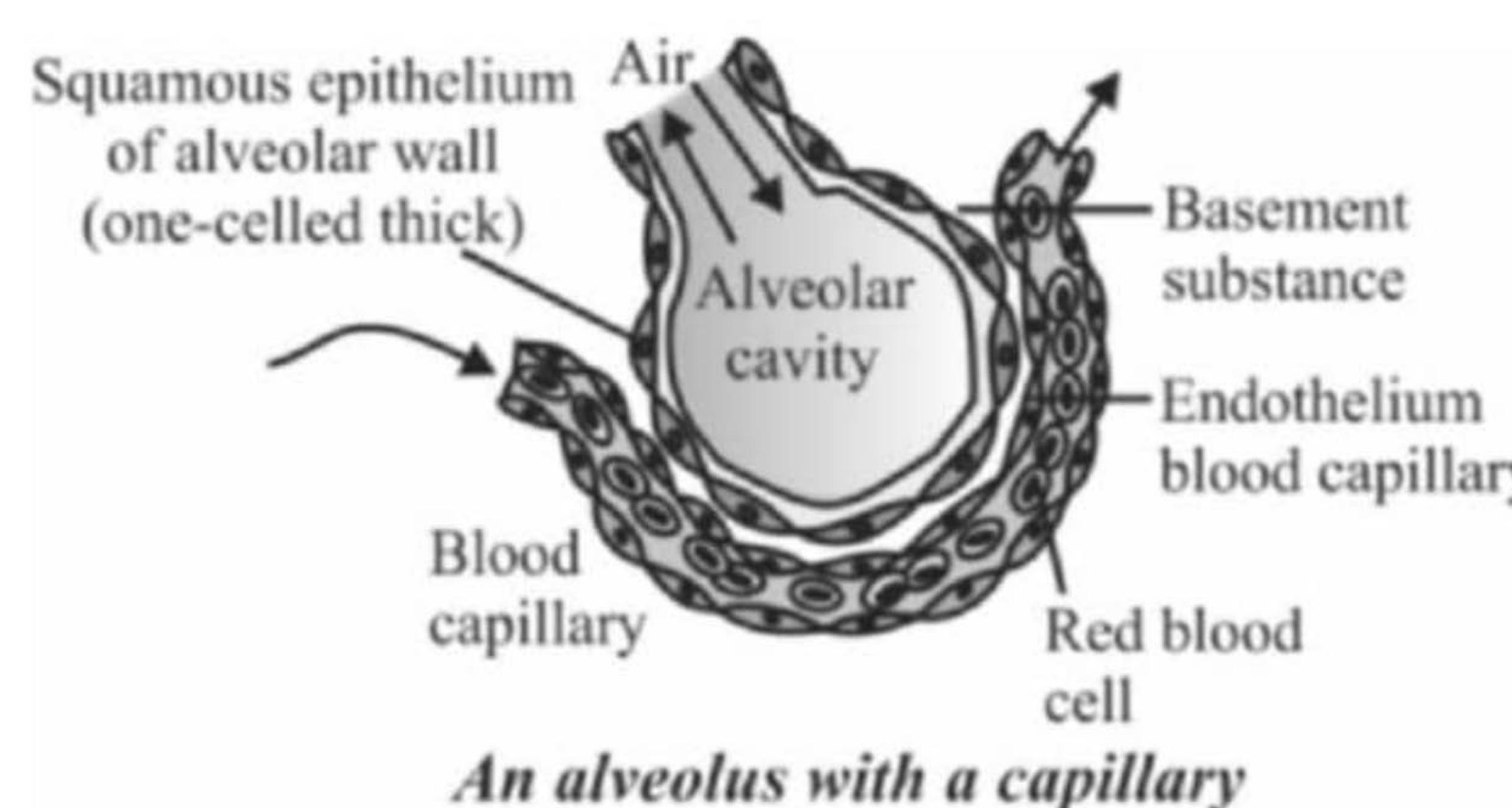
Lung Capacities

Tidal volume (TV)	Volume of air inspired or expired during a normal respiration	500 mL (6,000 to 8,000 mL min ⁻¹)
Inspiratory Reserve volume (IRV)	Additional volume of air, a person can inspire by a forcible inspiration.	2,500-3,000 mL
Expiratory Reserve Volume (ERV)	Additional volume of air, a person can expire by a forcible expiration.	1,000-1,100 mL
Residual volume (RV)	Volume of air remaining in the lungs even after a forcible expiration.	1,100-1,200 mL
Inspiratory capacity (IC)	Total (maximum) volume of air a person can inspire after a normal expiration	TV+IRV
Expiratory capacity (EC)	Total (maximum) volume of air a person can expire after normal inspiration	TV+ERV
Functional Residual capacity (FRC)	Volume of air that will remain in the lungs after a normal expiration	ERV+RV
Vital capacity (VC)	The maximum volume of air a person can breath in after a forced exhalation (or breath out after a forced inspiration)	IRV+TV+ERV
Total Lung Capacity (TLC)	Total volume of air accommodated in the lungs at the end of a forced inspiration	IRV+TV+ERV+RV (VC+RV)

Exchange of Gases

	Atmosphere	Alveoli	Deoxygenated blood	Oxygenated blood	Tissues
pO ₂ (mm HG)	159	104	40	95	40
pCO ₂ (mm HG)	0.3	40	45	40	45

- Alveoli are the primary sites of exchange of gases (pulmonary gas exchange).
- Exchange of gases also occurs between blood and tissues (systemic gas exchange).
- O₂ and CO₂ are exchanged in these sites by simple diffusion.
- Factors affecting the rate of diffusion:*
 - Pressure/concentration gradient (primary factor)
 - Solubility of the gases
 - Thickness of the membranes
- There is a concentration gradient for oxygen favours its diffusion from alveoli to blood and blood to tissues.
- Concentration gradient for CO₂ favours its diffusion from tissues to blood and blood to alveoli.
- As the solubility of CO₂ is 20-25 times higher than that of O₂, the amount of CO₂ that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O₂.
- Layers in the diffusion (respiratory) membrane:*
 - Squamous epithelium of alveoli
 - Basement substance
 - Endothelium of alveolar capillaries

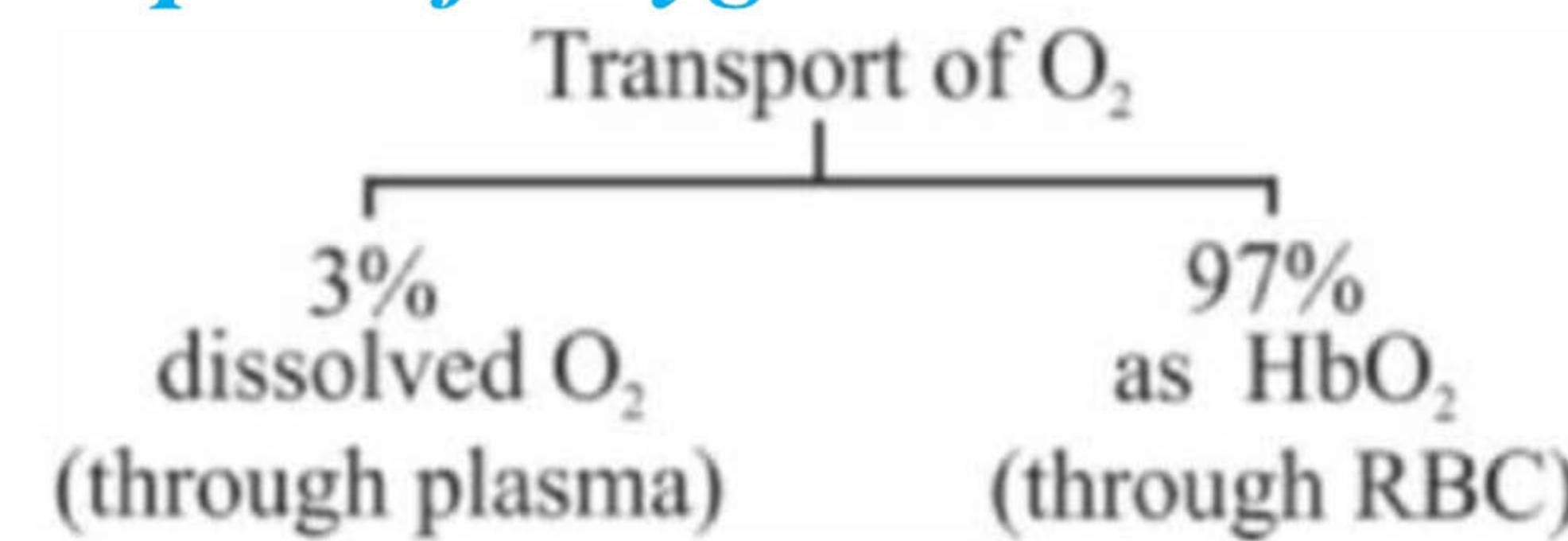


- The total thickness of basement substance is much less than a millimetre.

Transport Of Gases

- Blood is the medium of transport for O_2 and CO_2 .

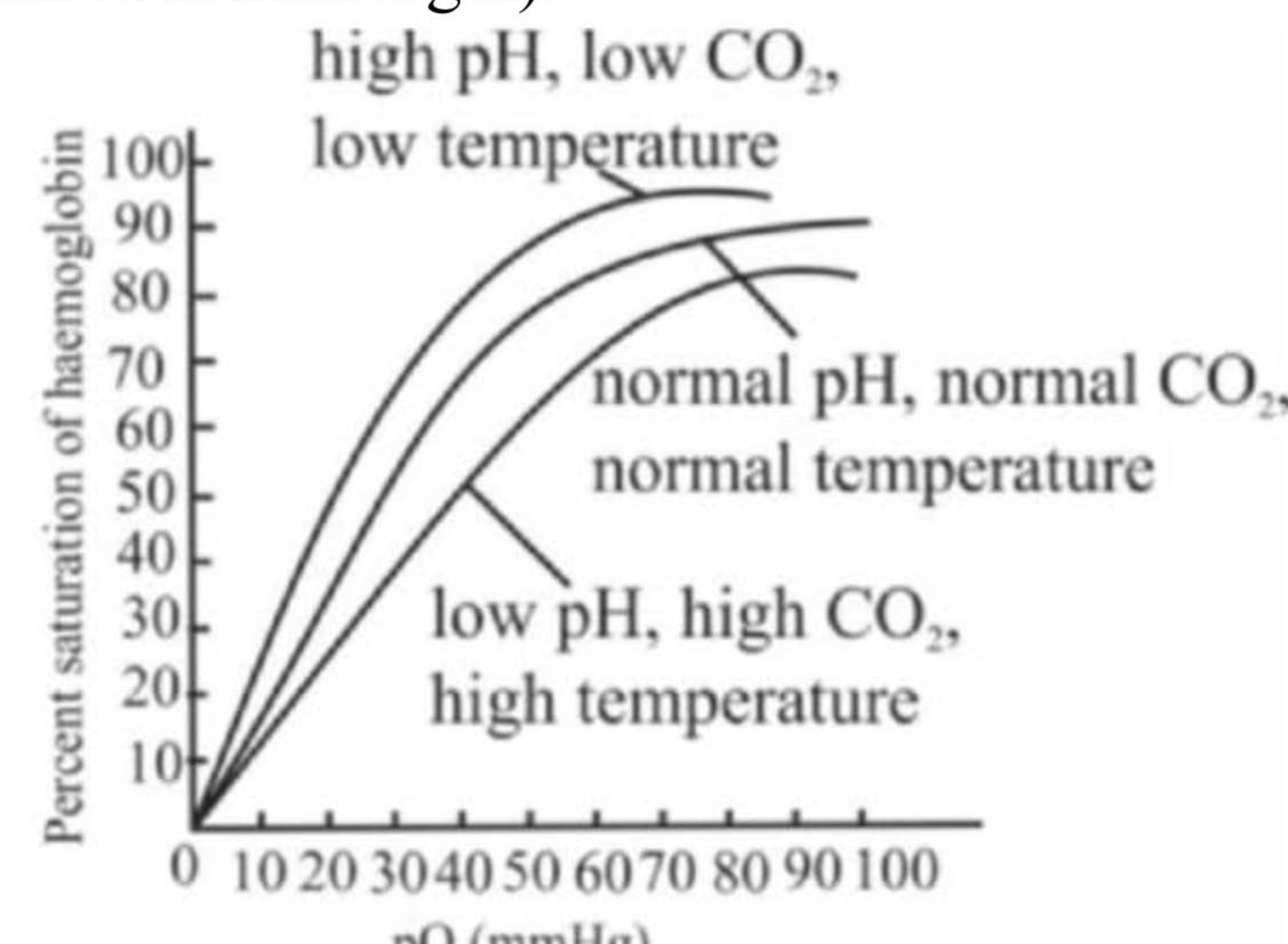
Transport of Oxygen



- Haemoglobin is a red coloured iron containing pigment present in the RBCs.
- It includes four haeme groups and four polypeptides (two alpha and two beta).
- One O_2 can bind to Fe^{2+} (ferrous ion) at the centre of each of the four haeme groups.
- Thus, each haemoglobin molecule can carry a maximum of four molecules of O_2 .
- Binding of oxygen with haemoglobin is primarily related to pO_2 .
- A sigmoid **oxygen dissociation curve** is obtained when percentage saturation of haemoglobin with O_2 is plotted against the pO_2 .

Conditions in the alveoli that favour the formation of HbO_2	Conditions in the tissues that favour the disassociation of HbO_2
$\uparrow pO_2$	$\downarrow pO_2$
$\downarrow pCO_2$	$\uparrow pCO_2$
$\downarrow H^+(\uparrow pH)$	$\uparrow H^+(\downarrow pH)$
\downarrow temperature	\uparrow temperature
$\downarrow 2,3$ BPG	$\uparrow 2,3$ BPG

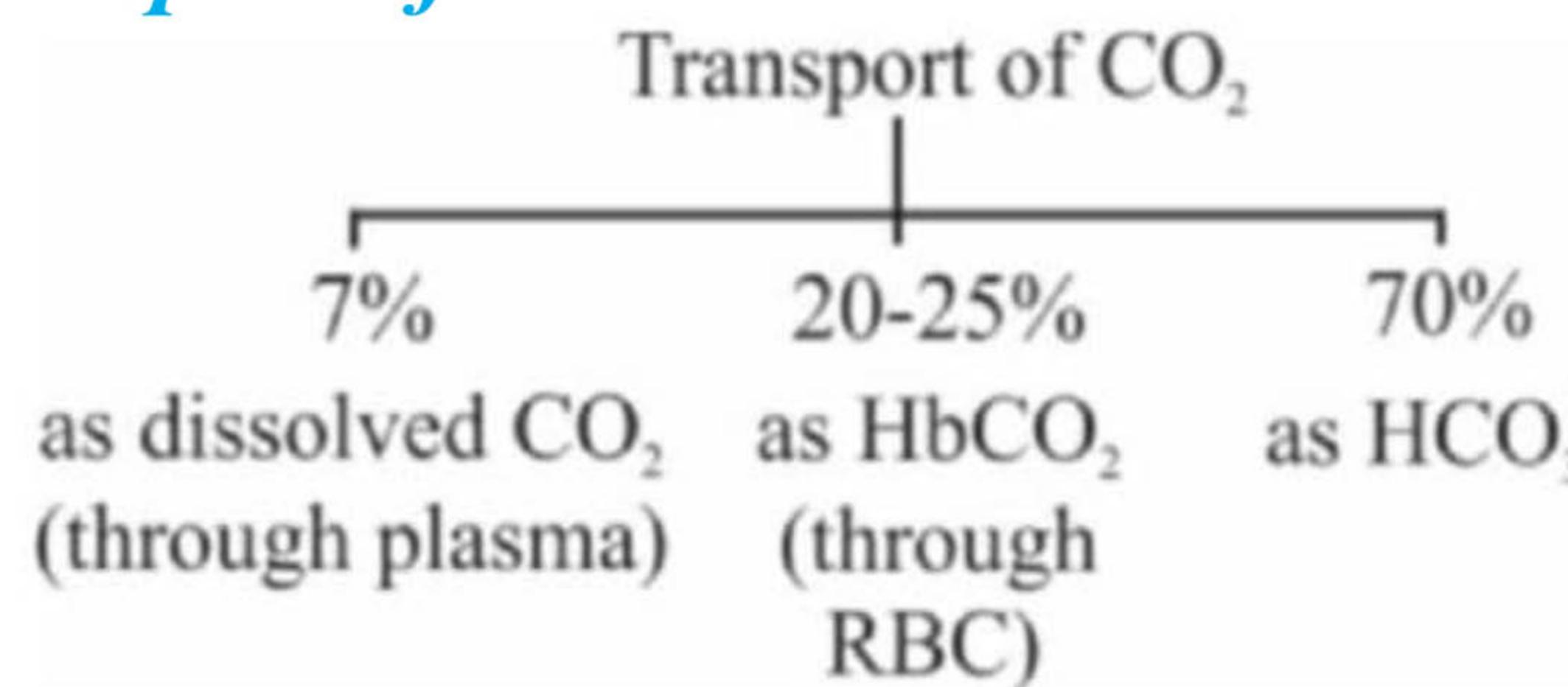
- Oxygen dissociation curve is highly useful in studying the effect of factors like pCO_2 , H^+ concentration, temperature, etc., on binding of O_2 with haemoglobin.
- Effect of CO_2 and H^+ on the oxygen-affinity of haemoglobin is termed **Bohr effect** (shifts the curve toward right).



Oxygen-haemoglobin dissociation curve and Bohr effect

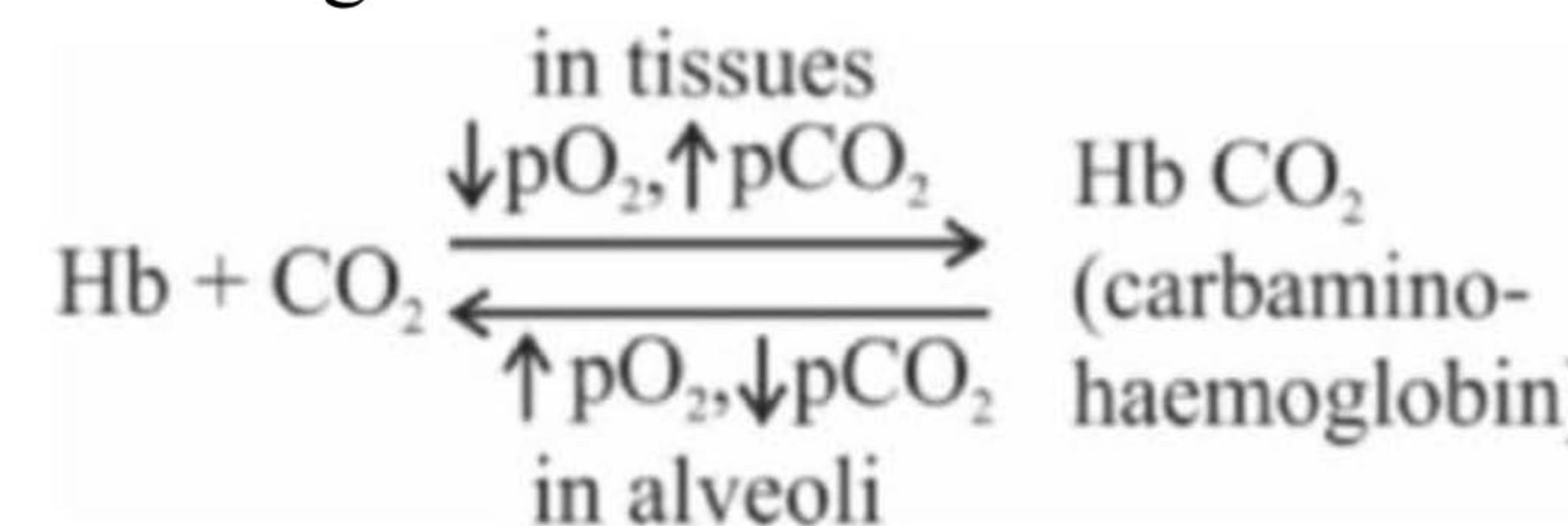
- Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

Transport of Carbon dioxide



As $HbCO_2$

- The binding of CO_2 to Hb is related to the partial pressure of CO_2 .
- pO_2 is a major factor which could affect this binding.



As Bicarbonates

- RBCs contain a very high concentration of the enzyme carbonic anhydrase.
- A minute quantities carbonic anhydrase is present in the plasma too.

- Carbonic anhydrase facilitates the following reaction in both directions.



At tissues:

- As pCO_2 is high, CO_2 forms HCO_3^- and H^+ .
- Some HCO_3^- diffuses into plasma in exchange for Cl^- (plasma membrane of RBC is impermeable to cations). This termed **chloride shift**, or Hamburger's phenomenon.

At alveoli:

- As pCO_2 is low, the reaction proceeds in the opposite direction leading to the formation of CO_2 and H_2O .
- HCO_3^- diffuses back into RBC and Cl^- diffuse back into plasma (reverse chloride shift).
- Thus, CO_2 trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO_2 .
- Every 100 ml of deoxygenated blood delivers approximately 4 ml of CO_2 to the alveoli.

Regulation Of Respiration

- Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is done by the neural system.
- Respiratory rhythm centre in the medulla is primarily responsible for the regulation of ventilation.
- Pneumotaxic centre can moderate the functions of the respiratory rhythm centre.

Center	Location	Function
Respiratory rhythm center	Medulla oblongata	Responsible for basic rhythm
Pneumotaxic center	Pons	Reduces duration of inhalation
Apneustic center	Pons	Increases duration of inhalation

- A **chemosensitive area** is situated adjacent to the rhythm centre which is highly sensitive to CO_2 and H^+ .

- Increase in CO_2 and H^+ can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.

- Receptors associated with **aortic arch** and **carotid artery** also can recognise changes in CO_2 and H^+ concentration and send necessary signals to the rhythm centre for remedial actions.
- The role of oxygen in the regulation of respiratory rhythm is quite insignificant.
- When you hold your breath, rising CO_2 level in the arterial blood would first lead to the urge to breathe (AIPMT 2015C).

Disorders Of Respiratory System

Asthma

- It is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

Emphysema

- It is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.
- One of the major causes of emphysema is cigarette smoking.
- Alpha-1-antitrypsin can be used in the treatment.

Occupational Respiratory Disorders:

- In certain industries, especially those involving grinding or stone-breaking, so much dust is produced that the defense mechanism of the body cannot fully cope with the situation.
- Long exposure to dust can give rise to inflammation leading to fibrosis and thus, serious lung damage.
- Workers in such industries should wear protective masks.

Asbestosis	Asbestos dust
Silicosis	Silica dust
Siderosis	Iron particles
Black-lung disease/anthracosis	Coal dust

Some Other Important Points Beyond Ncert Textbook:

- In birds, air sacs are connected to the lungs. The passage of air through the parabronchi is continuous and unidirectional. Hence always fresh air passes through parabronchi.
- Three thin twisted bony plates called nasal **conchae**, or turbinals curl out from the lateral walls of each nasal cavity.
- Thyroid is the largest cartilage of the larynx.
- The anterior prominence of the thyroid cartilage is called **Adam's apple** (larger in males).
- The space between the true vocal cords (vocal folds) is called the **rima glottidis**.
- The right lung has two lobes while the left lung has three lobes.
- Type II alveolar cells secrete alveolar fluid containing **surfactant**.
- Surfactant lowers the surface tension of alveolar fluid, which reduces the tendency of alveoli to collapse.
- Intrapleural pressure** is always less than alveolar pressure. This prevents complete collapse of alveoli during expiration (NEET-II 2016).
- Residual volume cannot be measured using normal spirometry (NEET 2017 R.L.).
- The capacity of 1 gram of haemoglobin to combine with oxygen is 1.34 ml.
- About 97% of haemoglobin is saturated at a pO_2 of 95 mmHg (in systemic arteries).
- About 75% of haemoglobin is saturated at a pO_2 of 40 mmHg (in resting tissues).
- A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissues. This O_2 acts as a reserve during muscular exercise (AIPMT 2011).
- The **P₅₀** is the oxygen tension at which haemoglobin is 50% saturated. The normal P₅₀ of haemoglobin is 26.7 mm Hg.
- Compared to adult haemoglobin (HbA), foetal haemoglobin (HbF) has higher affinity for oxygen (AIPMT 2009).



Exercise

01. Which one of the following statements is incorrect?

- Countercurrent flow of blood and water in gills of fishes enhances oxygenation.
- Most of the aquatic arthropods use special vascularized structures called gills for respiration.
- Larvae of amphibians perform branchial respiration.
- Arthropods use their cuticle for exchange of oxygen and carbon dioxide with the atmosphere.

02. Which one of the following groups of three animals is correctly matched with their respiratory organs?

	Animals	Respiratory organ(s)
(1)	Shark, snail, scorpion	Gills
(2)	Earthworm, tapeworm, silkworm	General body surface
(3)	Earthworm, frog, cockroach	Skin
(4)	Crocodile, crow, cat	Lungs

03. Trachea divides into primary bronchi at the level of

- 5th thoracic vertebra
- 7th cervical vertebra
- 1st thoracic vertebra
- Diaphragm

- People living at high altitudes have more number of RBC per microliter of blood (physiological polycythaemia; AIPMT 2006).
- Binding of oxygen with haemoglobin tends to displace CO_2 from the blood. This is called the **Haldane effect**.
- When CO_2 concentration in blood increases breathing becomes faster and deeper (hyperventilation) (AIPMT 2004).

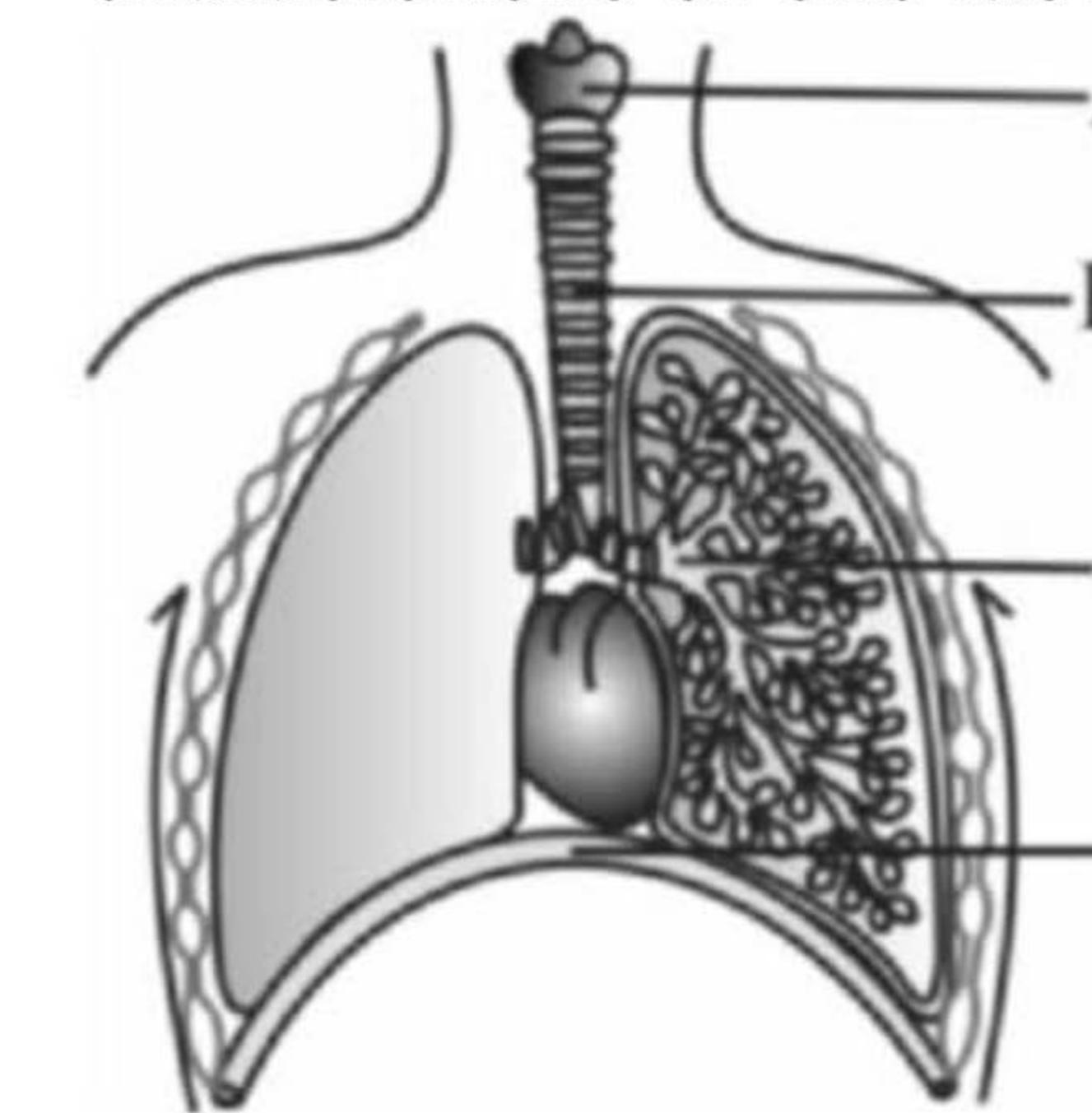
04. Select the correct path of passage of air through the human respiratory tract.

- Primary bronchiole → secondary bronchus → alveolar duct → alveolus
- Larynx → pharynx → trachea → bronchus → alveolus
- Secondary bronchus → primary bronchiole → terminal bronchiole → alveolus
- External nostril → pharynx → trachea → larynx → bronchus

05. Which of the following lacks cartilage?

- Larynx
- Terminal bronchiole
- Trachea
- Tertiary bronchus

06. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option that gives correct identification and main function or characteristic of one label.



- | | |
|---------------------|---------------------------------------------|
| (1) A: Epiglottis - | Prevents the entry of food into the larynx |
| (2) B: Trachea - | Lined by simple squamous epithelium |
| (3) C: Bronchus - | Supported by incomplete cartilaginous rings |
| (4) D: Diaphragm - | Contracts during expiration |

07. Which of the following is not a function of the nose?

- Warming and moistening the inhaled air
- Filtering dust particles from the inhaled air
- Detection of olfactory stimuli
- Exchange of respiratory gases

08. Which of the following is not correctly paired with its description?

- | | |
|----------------------------|-------------------------------------------------------------------------------------------|
| (1) Ventilation : | Drawing of atmospheric air into the lungs and releasing CO_2 -rich alveolar air outside |
| (2) Cellular respiration : | Utilisation of O_2 by the cells for anabolic reactions |
| (3) Pleural fluid : | Reduces friction on the lung surface |
| (4) Spirometer : | Used for measuring the volume of air involved in breathing |

09. Select the correct statement about breathing in man.

- Expiration is initiated due to the contraction of the diaphragm.
- Inpiration can occur if there is a negative pressure in the lungs with respect to atmospheric pressure.
- Contraction of the diaphragm increases the volume of the thoracic chamber in dorsoventral axis
- The anatomical setup of lungs in the thorax is such that any change in the lung volume will be reflected in the volume of the thoracic cavity.

10. Inspiration is initiated by the

- Contraction of the diaphragm
- Relaxation of the diaphragm
- Contraction of the internal intercostal muscles
- Relaxation of the external intercostal muscles

11. Which of the following occurs during exhalation?

- Diaphragm becomes arched upwards
- Ribs and sternum are raised up
- External intercostal muscles contract
- Negative pressure in the lungs with respect to atmospheric pressure

12. Tidal volume is about ____ percent of total lung capacity.

- (1) 14 (2) 20 (3) 3 (4) 8

13. Which of the following cannot be measured by normal spirometry?

- (1) Residual volume
(2) Tidal volume
(3) Inspiratory reserve volume
(4) Vital capacity

14. Lung volumes of a person are given below.

$$\text{Tidal volume} = 500 \text{ mL}$$

$$\text{Inspiratory reserve volume} = 1900 \text{ mL}$$

$$\text{Expiratory reserve volume} = 700 \text{ mL}$$

$$\text{Residual volume} = 1100 \text{ mL}$$

Calculate the inspiratory capacity of the person.

- (1) 3100 mL
(2) 2400 mL
(3) 4500 mL
(4) 1200 mL

15. Volume of air that remains in the lungs after a normal expiration is termed

- (1) Residual volume
(2) Expiratory reserve volume
(3) Functional residual capacity
(4) Vital capacity

16. The maximum volume of air a person can breathe in after a forced expiration is termed

- (1) Vital capacity
(2) Total lung capacity
(3) Expiratory capacity
(4) Inspiratory capacity

17. Which of the following is true about lung volumes?

- (1) Residual volume > expiratory reserve volume
(2) Residual volume < tidal volume
(3) Inspiratory reserve volume = expiratory reserve volume
(4) Tidal volume = residual volume

18. Which of the following pairs is correctly matched?

- (1) Vital capacity : ERV+IRV
(2) Total lung capacity : VC + RV
(3) Functional residual capacity: ERV + TV
(4) Inspiratory capacity: TV + ERV

19. Match the items given in Column I with those in Column II and select the correct option given below:

Column I	Column II
a. Tidal volume	i. 2500 – 3000 mL
b. Inspiratory Reserve volume	ii. 1100 – 1200 mL
c. Expiratory Reserve volume	iii. 500 mL
d. Residual volume	iv. 1000 – 1100 mL
	a b c d
(1) i iv ii iii	
(2) iii ii i iv	
(3) iii i iv ii	
(4) iv iii ii i	

20. Listed below are four respiratory capacities (i-iv) of a normal human adult and four jumbled formulae.

i	Functional residual volume	TV+IRV+ERV+RV
ii	Total lung capacity	TV+IRV
iii	Inspiratory capacity	ERV+RV
iv	Vital capacity	TLC-RV

Which one of the following is the correct matching of two capacities and their formulae?

- (1) (ii) TV+IRV+ERV+RV (iii) ERV+RV
(2) (iii) TV+IRV (iv) TV+IRV+ERV+RV
(3) (i) TV+IRV (ii) ERV+RV
(4) (iv) TLC-RV (i) ERV+RV

21. The exchange of gases in the alveoli of the lungs takes place by

- (1) Primary active transport
(2) Secondary active transport
(3) Simple diffusion
(4) Facilitated diffusion

22. Which of the following are equal?

- (1) pCO_2 in the alveoli and pO_2 resting tissues
(2) pO_2 in the deoxygenated blood and pCO_2 resting tissues
(3) pO_2 in the alveoli and pO_2 in the oxygenated blood

(4) pCO_2 in the carotid artery and pCO_2 in the pulmonary artery

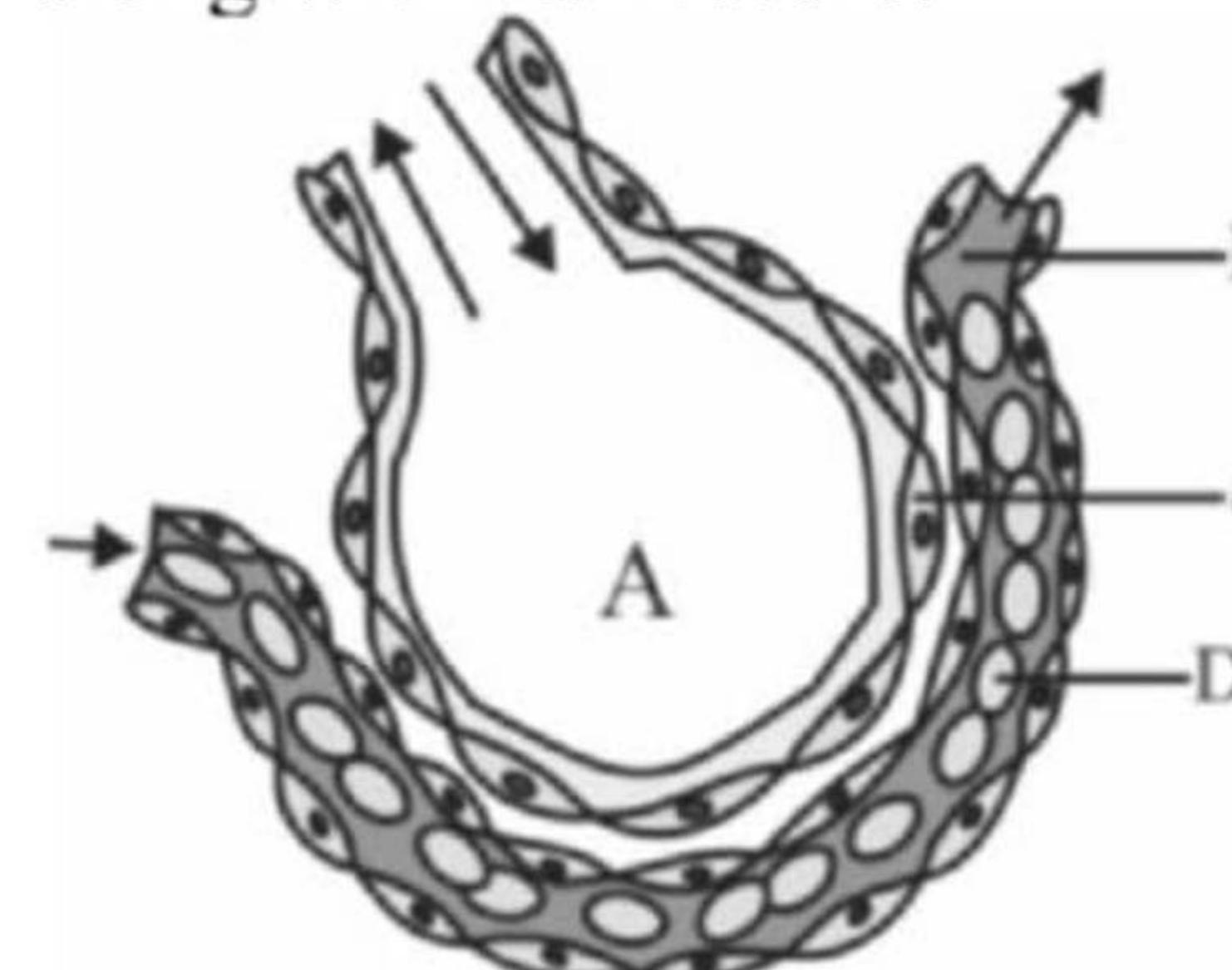
23. Choose the correct sequence representing the partial pressure of oxygen (in mm Hg) in atmospheric air, alveolar air, deoxygenated blood, oxygenated blood, and resting systemic tissues.

- (1) 159, 104, 40, 95 and 40
(2) 0.3, 40, 45, 40 and 45
(3) 159, 104, 40, 45 and 40
(4) 0.3, 40, 40, 40 and 45

24. The amount of CO_2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O_2 because

- (1) Molecular weight of CO_2 is greater than that of O_2
(2) CO_2 diffuses easily through gap junctions in the alveolar epithelium while O_2 has to diffuse through tight junctions
(3) CO_2 is water-soluble whereas O_2 is lipid-soluble
(4) Solubility of CO_2 is much higher compared to that of O_2

25. The figure given below shows a small part of human lung where exchange of gases takes place. Select the option which represents a labelled part (A, B, C or D) correctly identified along with its feature.



- | | |
|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) C: Endothelium
(2) A: Alveolus
(3) B: Capillary
(4) D: Erythrocyte | <ul style="list-style-type: none"> - Simple squamous epithelium - Only site of gas exchange - Drains into pulmonary artery - Contains carbonic anhydrase |
|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

26. Which of the following is transported, at least partly, in a dissolved through the blood plasma?

- (1) Oxygen only
(2) Both oxygen and carbon dioxide
(3) Carbon dioxide only
(4) Neither oxygen nor carbon dioxide

27. The majority of carbon dioxide produced by our body cells is transported to the lungs as

- (1) Carbaminohaemoglobin
(2) Dissolved carbon dioxide
(3) Bicarbonates
(4) Carboxyhaemoglobin

28. The percentage of carbon dioxide that is transported from the tissues to the lungs as carbamino compounds is

- (1) 7
(2) 20-25
(3) 70
(4) 3

29. Which of the following would decrease the affinity of haemoglobin for oxygen?

- (1) Low pH
(2) Low temperature
(3) Low BPG
(4) Low H^+ concentration

30. Which of the following is the best description of Bohr effect?

- (1) Increase in oxygen affinity of haemoglobin with falling blood pH
(2) Binding of H^+ converts hemoglobin to R state
(3) Decrease in oxygen affinity of haemoglobin with falling blood pH
(4) Increase in oxygen affinity of haemoglobin with increasing temperature

31. Which of the following is true about foetal haemoglobin (HbF)?

- (1) Its oxygen-haemoglobin dissociation curve is to the right of the curve for adult haemoglobin (HbA)
(2) Its affinity for oxygen is higher than that of adult haemoglobin
(3) It contains two alpha chains and two beta chains

- (4) It binds BPG more tightly than does adult haemoglobin
- 32.** Which of the following best describes Hamburger's phenomenon?
- Exchange of chloride and bicarbonate ions between the plasma and the RBCs
 - Effect of carbon dioxide on the oxygen affinity of haemoglobin
 - Oxygenation of haemoglobin in the lungs displaces carbon dioxide from the blood
 - The amount of a gas that will dissolve in a liquid is proportional to the partial pressure of the gas and its solubility
- 33.** Although H^+ ions are produced in the RBCs in systemic capillaries, blood does not become too acidic because
- Carbonic anhydrase enzyme is present in the RBCs
 - H^+ ions combine with HCO_3^- to form H_2CO_3 in the systemic capillaries
 - Chloride shift occurs in systemic capillaries
 - Histidine residues in hemoglobin can accept protons and act as buffers
- 34.** Carbonic anhydrase catalyzes the
- Dissociation of H_2CO_3 into CO_2 and H_2O in systemic capillaries
 - Dissociation of H_2CO_3 into H^+ and HCO_3^- in pulmonary capillaries
 - Formation of H_2CO_3 from CO_2 and H_2O in systemic capillaries
 - Formation of H_2CO_3 from CO_2 and H_2O in pulmonary capillaries
- 35.** Every 100 ml of deoxygenated blood delivers approximately ___ mL of CO_2 to the alveoli.
- 5
 - 4
 - 3
 - 2
- 36.** The basic respiratory rhythm is established by a respiratory centre located in the
- Pons
 - Medulla oblongata
 - Cerebellum
 - Thoracic segment of the spinal cord
- 37.** Neural signals from pneumotaxic centre
- Reduce the duration of inhalation
 - Increase the duration of inhalation

- (3) Reduce the breathing rate
- (4) Increase the tidal volume
- 38.** When you hold your breath, which of the following stimulus would first lead to the urge to breathe?
- Falling O_2 concentration in the blood
 - Falling CO_2 concentration in the blood
 - Rising pH of the blood
 - Rising CO_2 concentration in the blood
- 39.** Chemoreceptors that are involved in the regulation of pulmonary ventilation are associated with
- Aortic arch and coronary arteries
 - Pulmonary trunk and aortic arch
 - Carotid artery and aortic arch
 - Pulmonary artery and pulmonary vein
- 40.** Pneumotaxic centre is located in the
- Pons
 - Medulla oblongata
 - Cerebellum
 - Hypothalamus
- 41.** Select the correct statement.
- Endocrine system directly modulates the respiratory rhythm to suit the demands of the body tissues.
 - Intercostal muscles are skeletal muscles hence are purely voluntary in nature.
 - The role of oxygen in the regulation of respiratory rhythm is quite insignificant.
 - Respiratory rhythm centre is present in the cerebellum.
- 42.** Asthma is due to
- Damage to alveolar walls
 - Inflammation of bronchi and bronchioles
 - Streptococcal bacterial infection
 - Paralysis of bronchial muscles
- 43.** Pulmonary fibrosis is most commonly associated with
- Asthma
 - Emphysema
 - Pneumonia
 - Asbestosis
- 44.** Which of the following options correctly represents the conditions in asthma and emphysema, respectively?

- (1) Nasal congestion; inflammation of bronchioles
- (2) Spasm of bronchial muscles; increased respiratory surface
- (3) Inflammation of bronchioles; decreased respiratory surface
- (4) Decreased respiratory surface; Inflammation of bronchioles
- 45.** Which of the following is not an occupational respiratory disorder?
- Silicosis
 - Anthracosis
 - Siderosis
 - Emphysema

ANSWER KEY

1. 4	2. 4	3. 1	4. 3	5. 2
6. 3	7. 4	8. 2	9. 2	10. 1
11. 1	12. 4	13. 1	14. 2	15. 3
16. 1	17. 1	18. 2	19. 3	20. 4
21. 3	22. 1	23. 2	24. 4	25. 4
26. 2	27. 3	28. 2	29. 1	30. 3
31. 2	32. 1	33. 4	34. 3	35. 2
36. 2	37. 1	38. 4	39. 3	40. 1
41. 3	42. 2	43. 4	44. 3	45. 4

HINTS & SOLUTIONS

- 01.** Cutaneous respiration occurs in annelids; not arthropods. Aquatic arthropods respire through gills or book gills. Terrestrial arthropods respire through tracheae or book lungs.
- 02.** Reptiles (e.g. crocodile), birds (e.g. crow) and mammals (e.g. cat) respire through lungs. Scorpion – book lungs (not gills); silkworm – tracheae (not body surface); cockroach – tracheae (not skin);
- 03.** The trachea is a straight tube extending up to the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
- 04.** External nostril → nasal chamber → internal nostril → pharynx → glottis → larynx → trachea → primary bronchus → secondary bronchus → tertiary bronchus → primary bronchiole → secondary bronchiole → tertiary bronchiole → terminal bronchiole → respiratory bronchiole → alveolar duct → alveolar sac → alveolus.
- 05.** The tracheae, primary, secondary and tertiary bronchi, and initial bronchioles are supported by incomplete cartilaginous rings.
- 06.** The trachea, bronchi and initial bronchioles are supported by C-shaped (incomplete) cartilage rings. 'A' is not the epiglottis but the thyroid cartilage of the larynx. The trachea is lined by pseudostratified columnar ciliated epithelium (not simple squamous); The diaphragm contracts during inspiration but not expiration.
- 07.** Exchange of gases occurs in the conducting part of the respiratory tract. The parts starting from the external nostrils up to the terminal bronchioles constitute the conducting part. The conducting part transports the atmospheric air to the alveoli, clears it from foreign particles, humidifies and also brings the air to body temperature.
- 08.** Cellular respiration is the utilisation of O_2 by the cells for catabolic reactions (not anabolic).
- 09.** Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure, i.e., there is a negative pressure in the lungs with respect to atmospheric pressure.
- 10.** Inspiration is initiated by the contraction of diaphragm which increases the volume of the thoracic chamber in the antero-posterior (vertical) axis.
- 11.** During exhalation, the diaphragm relaxes and becomes arched upwards (Ref. Fig. 17.2, NCERT Class XII Textbook).
- 12.** Tidal (500 mL) volume is about 8% of total lung capacity (about 6,000 mL).
- 13.** Residual volume cannot be measured by spirometry because it is neither inhaled nor exhaled.

14. In that person:

$$\text{IC} = \text{TV} + \text{IRV} = 500 + 1,900 = 2,400 \text{ mL}$$

15. The volume of air that remains in the lungs after a normal expiration is termed functional residual capacity (FRC). $\text{FRC} = \text{ERV} + \text{RV}$.

16. Vital capacity is the maximum volume of air a person can breathe in after a forced expiration (or) the maximum volume of air a person can breathe out after a forced inspiration.

$$\text{VC} = \text{ERV} + \text{TV} + \text{IRV}.$$

17. $\text{TV} (500 \text{ mL}) < \text{ERV} (1000-1100 \text{ mL}) < \text{RV} (1100-1200 \text{ mL}) < \text{IRV} (2500-3000 \text{ mL})$

$$\text{TLC} = \text{VC} + \text{RV}$$

$$\text{VC} = \text{IRV} + \text{TV} + \text{ERV}$$

$$\text{FRC} = \text{ERV} + \text{RV}$$

$$\text{IC} = \text{TV} + \text{IRV}$$

$$\text{19. TV} = 500 \text{ mL}$$

$$\text{IRV} = 2500-3000 \text{ mL}$$

$$\text{ERV} = 1000-1100 \text{ mL}$$

$$\text{RV} = 1100-1200 \text{ mL}$$

$$\text{20. FRC} = \text{ERV} + \text{RV}$$

$$\text{TLC} = \text{TV} + \text{IRV} + \text{ERV} + \text{RV} - (1)$$

$$\text{IC} = \text{TV} + \text{IRV}$$

$$\text{VC} = \text{IRV} + \text{TV} + \text{ERV} - (2)$$

From (1) and (2) we can derive that:

$$\text{VC} = \text{TLC} - \text{RV}$$

21. O_2 and CO_2 are exchanged through the diffusion membrane (respiratory membrane) by simple diffusion mainly based on pressure/concentration gradient.

22. pCO_2 in the alveoli (40 mm Hg) = pO_2 in the resting systemic tissues (40 mm Hg)

23. pCO_2 at different parts is as follows:

Atmospheric air - 0.3 mm Hg

Alveolar air - 40 mm Hg

Deoxygenated blood - 45 mm Hg

Oxygenated blood - 40 mm Hg

Resting tissues - 45 mm Hg

24. According to Henry's law, the amount of a gas that will dissolve in a liquid is proportional to the partial pressure of the gas and its solubility.

As the solubility of CO_2 is 20-25 times higher than that of O_2 , the amount of CO_2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O_2 .

25. Carbonic anhydrase enzyme present in the erythrocytes catalyzes the formation of carbonic acid from CO_2 and H_2O and its dissociation into H^+ and HCO_3^- at tissues. It also catalyzes the reverse reactions at the lungs. 'C' is alveolar epithelium (not endothelium which is the epithelium of the blood capillary). Exchange of gases occurs not only in the alveoli but also in the respiratory bronchioles, alveolar ducts and at systemic tissues. Pulmonary capillary drains oxygenated blood into the pulmonary vein (not the pulmonary artery).

26. Three percent of O_2 is carried in a dissolved state through the plasma. About 7 percent of CO_2 is carried in a dissolved state through plasma.

27. 70 percent of CO_2 is carried from the tissues to the lungs as bicarbonate.

28. About 20-25% of CO_2 is transported from the tissue to the lungs by haemoglobin as carbaminohaemoglobin.

29. Low pO_2 , high pCO_2 , Low pH (high H^+) and high temperature favour dissociation of O_2 from HbO_2 . The effect of CO_2 and H^+ on the oxygen affinity of haemoglobin is termed Bohr effect.

30. The effect of CO_2 and H^+ on the oxygen affinity of haemoglobin is termed Bohr effect. High pCO_2 and Low pH would decrease the oxygen affinity of haemoglobin and thus favour unloading of O_2 from HbO_2 at tissues.

31. The oxygen affinity of HbF is greater than that of HbA . Its oxygen-haemoglobin dissociation curve is to the left of the dissociation curve of HbA .

32. The exchange of Cl^- and HCO_3^- ions between the plasma and the RBC is called the chloride shift or Hamburger's phenomenon. In

systemic capillaries, CO_2 enters the RBCs and reacts with H_2O , in the presence of carbonic anhydrase, to form H_2CO_3^- which dissociates into H^+ and HCO_3^- . Some HCO_3^- diffuses out into the blood plasma, down its concentration gradient. The plasma membrane of the RBCs is nearly impermeable to cations. To maintain the electrical balance between blood plasma and RBCs, Cl^- move from the blood plasma into the RBC.

33. Histidine is a basic amino acid. Histidine residues in haemoglobin can accept H^+ and act as buffers.

34. At the tissues, carbonic anhydrase enzyme present in the erythrocytes catalyzes the formation of H_2CO_3 from CO_2 and H_2O and its dissociation into H^+ and HCO_3^- at tissues. At the alveoli, it catalyzes the formation of H_2CO_3 from H^+ and HCO_3^- its dissociation into CO_2 and H_2O .



35. Every 100 mL of deoxygenated blood delivers approximately 4mL of CO_2 to the alveoli.

36. A specialised centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for the regulation of respiratory rhythm. The pneumotaxic centre present in the pons can moderate the functions of the respiratory rhythm centre.

37. Neural signals from the pneumotaxic centre can reduce the duration of inspiration and thereby alter (reduce) the respiratory rate.

38. A chemosensitive area is situated adjacent to the rhythm centre as well as the chemoreceptors associated with aortic arch and carotid artery are highly sensitive to CO_2 and H^+ . Increase in CO_2 and H^+ signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated. The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

39. Receptors associated with aortic arch (aortic bodies) and carotid artery (carotid bodies) can recognise changes in CO_2 and H^+ concentration and send necessary signals to the rhythm centre for remedial actions.

40. The pneumotaxic centre is present in the pons. It can moderate the functions of the respiratory rhythm centre. Neural signals from the pneumotaxic centre can reduce the duration of inspiration and thereby alter (reduce) the respiratory rate.

41. The role of oxygen in the regulation of respiratory rhythm is quite insignificant. Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is done by the neural system (not the endocrine system). Though intercostal muscles and diaphragm are skeletal muscles, they have both voluntary and involuntary controls (breathing is involuntary most of the time). Respiratory rhythm centre is present in the medulla oblongata (not the pons).

42. Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

43. In case of occupational respiratory disorders (asbestosis, silicosis, etc.) prolonged exposure to dust can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage.

44. Asthma – inflammation of bronchioles
Emphysema – decreased respiratory surface

45. Occupational lung diseases are work-related lung conditions that have been caused or made worse by the materials a person is exposed to with in the workplace (e.g. silicosis, asbestosis, anthracosis, siderosis, etc.). Emphysema is not an occupational respiratory disorder. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of emphysema is cigarette smoking.

(NES).....A competitive edge for cracking NEET

NEET Edge Series

Strategies For Enhancement In Food Production (Animal Breeding), Organisms & Population

Strategies For Enhancement In Food Production (Animal Breeding)

- Consider the following
 - Homozygosity
 - Heterozygosity
 - Fitness

When an animal population is subjected to cross breeding which of the above is/are reduced?

 - i only
 - ii & iii only
 - i & iii only
 - i, ii & iii
- Outcross is an individual produced from mating between which of the following?
 - Same breed and closely related individuals
 - Different breed and closely related individuals
 - Same breed and not closely related individuals
 - Different breeds and not closely related individuals
- Reduced fertility and productivity in animals due to continued inbreeding can be overcome by
 - Mating superior males of one breed with superior females of other breed.
 - Mating animals within same breed but having no common ancestors for upto 4-6 generations.

- Mating between animals of same breed for 4-6 generations.
- Mating between male and female animals of two different species.
- Choose incorrect statement regarding multiple ovulation embryo transfer technology (MOET)
 - It is a controlled breeding experiments
 - This technique is applied only to increase hybrid production rate
 - FSH hormone is given to the cattle for follicular maturation and superovulation
 - Semen of superior male is collected and injected into the reproductive tract of selected female with desirable traits
- Which of the following is/are important species of honeybee utilised in apiculture are

i. Apis mellifera	ii. Apis indica
iii. Apis dorsata	iv. Apis florea
(a) i, ii	(b) i, ii & iii
(c) i, ii, iii, iv	(d) ii & iv
- Which one of the following is arrhenotok?
 - Drones are male honeybees which develop from unfertilised eggs.
 - Haploids individuals develop from parthenogenesis.
 - Drones are female honey bees which develop from fertilised eggs.

- Drones are sterile honeybees and
- Which of the following procedures is/are followed in dairy farm management?
 - usage of manure to increase crop yields
 - regular inspections and visits by veterinary doctors
 - adequate environmental condition is provided
 - weeding away unproductive and harmful plants from the brood house.
 - i and ii are correct
 - ii and iii are correct
 - iii and iv are correct
 - i and iii are correct
- Which of the following points should be kept into consideration for successful bee keeping?
 - light management according to the habits of honeybees
 - selection of suitable location for keeping the beehives
 - knowledge of the behaviour of honey bees
 - handling and collection of honey and bee wax.
 - i, ii, iii
 - i, iii, iv
 - i, ii, iii, iv
 - ii, iii, iv
- Identify the true statements-
 - Pullorum disease of poultry is caused by virus.
 - Drones are produced by parthenogenesis.
 - Heterosis or hybrid vigour is the phenotypic superiority of the hybrid over either of its parents in one or more traits.
 - A clone contains and expresses genetically engineered gene known as transgene.
 - Cross breeding is practiced to develop homozygous pureline.
 - i, iv and v
 - ii and iii
 - All
 - None
- Following methodology has been used for cattle, sheep, buffaloes etc.


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        Cow is administrated with (1) hormone
        ↓
        (2)
        ↓
        6-8 eggs per cycle are derived
        ↓
        Artificially inseminated
        ↓
        Fertilized eggs at 8-32 cells are recovered
        ↓
        (3)
      
```

 - 1-LH, 2-Superovulation due to induced follicular maturation, 3- Transfer to surrogate mother
 - 1-FSH, 2-Superovulation due to induced follicular maturation, 3- transfer to surrogate mother
 - 1-progesteron, 2-Superovulation due to induced follicular maturation, 3-Transfer to surrogate mother
 - 1-Estrogen, 2-superovulation due to induced follicular maturation,3-Transfer to surrogate mother

Organisms and Population

- The most striking difference between tropical rain forest and temperate forest is that
 - The tropical rain forests have preponderance of angiosperms while the temperate one have preponderance of gymnosperms
 - The trees of temperate forest are taller than those of tropical rain forests
 - Giants of temperate forests are comparatively mesophytic
 - Tropical forests are comparatively more mesogenic
- Some organisms are able to maintain homeostasis by physiological (sometimes

- behavioural also) means which ensure constant body temperature, constant osmotic concentration etc. are called
- Regulators
 - Conformers
 - Parasites
 - Predator
3. Thermoregulation is energetically expensive for many organisms particularly
- Small animals
 - Shrews
 - Humming birds
 - All the above
4. If the stressful external condition are localised or remain only for a short duration, the organism has some alternatives like
- Regulate
 - Conform
 - Migrate
 - Suspend
5. In polar seas, aquatic a like b have a thick layer of fat called c below their skin that acts as an d and reduces loss of body heat.
- a-fishes, b-sharks, c-clasper, d-conductor
 - a-mammals, b-seals, c-blubber, d-insulator
 - a-fishes, b-seals, c-blubber, d-insulator
 - a-mammals, b-seals, c-blubber, d-conductor
6. In higher plants, which structure serve as means to tide over period of stress and also helps in dispersal
- Seed
 - Vegetative reproductive structures / propagules
 - both (a) and (b)
 - Spores
7. Read the following statements and find out the incorrect statement
- Microbes / archaebacteria flourish in hot springs and deep sea hydrothermal vents where temperature exceed 100°C
 - Many fish thrive in Antarctic waters where the temperature is always below zero
 - A large variety of marine invertebrates and fish live at great depths in the ocean where the pressure could be >100 times than the normal atmospheric pressure
 - Desert lizard have physiological ability that mammals have to deal with high temperature of their habitat

8. If a population growing exponentially doubles in size in 3 years, what is the intrinsic rate of increase (r) of the population? ($\log_{10}e=0.434$)
- 0.231
 - 0.168
 - 0.173
 - 0.184
9. In a laboratory there are 40 fruit flies last week and during experiment 4 fruit flies died in a week. Calculate the death rate.
- 0.1 individual per fruitfly per year
 - 0.36 individual per fruitfly per week
 - 0.4 individual per fruitfly per week
 - 0.1 individual per fruitfly per week
10. In a population showing logistic growth, $r=0.15$ per capita per year and the carrying capacity of the habitat is 2,000 individuals. What is the population growth rate (dN/dt) when the number of individuals (N) in the population is 1200?
- 120
 - 180
 - 72
 - 80
11. No predator can become proficient at acquiring prey because _____
- Predators are too large to be fast enough
 - Prey populations evolve antipredatory traits
 - Prey populations evolve more rapidly than predator populations
 - Predators are not as intelligent as their prey
12. Choose the correct sequence of stages of growth curve for bacteria :
- Lag, log, stationary, decline phase
 - Lag, log, stationary phase
 - Stationary, lag, log, decline phase
 - Decline, lag, log phase
13. In 2000, for each of the 14 million people present in a country, 0.036 were born and 0.016 died during the year. Using exponential equation, the number of people present in 2010 is predicted as
- 14 million
 - 2.8 million
 - 16.8 million
 - 0.20 million
14. How many insects are known to be phytophagous
- 25%
 - 50%
 - 50%
 - 18%
15. Which one provide the evidence for the occurrence of competition in nature?
- (a) Resource partitioning
- (b) Competitive release
- (c) Mac Arthur experiment
- (d) All of the above
16. Which of the following best describes the principle of competitive exclusion in wake of Mac Arthur's findings?
- Competition between two species causes extinction of one species
 - Two species occupying exactly the same niche cannot coexist in a community
 - Competition in a population decreases survival of the best-adapted individuals
 - No two species can coexist in the same habitat
17. The feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources are abundant then it is called
- Resource partitioning
 - Competitive release
 - Interference competition
 - Competitive exclusion
18. When certain exotic species are introduced into a geographical area, they become invasive and spread because the invaded land does not have its natural
- Competitor
 - Predator
 - Parasite
 - Symbionts
19. In estuaries, salinity levels typically decline in the rainy season and rise during the summer. Which organisms are adapted to live in such environments?
- Stenohaline
 - Homeothermic
 - Euryhaline
 - Stenothermal
20. Which is not a characteristic of intestinal symbionts?
- Feeding on extra food of host
 - Providing vitamins to host
 - Anaerobic respiration
 - Aerobic respiration
21. In an area there are 200 Parthenium plant but only a single huge banyan tree with a large canopy. The population density is measured in terms of
- (a) Number of biomass
- (b) Number of percent cover
- (c) Biomass or percent cover
- (d) Number, biomass or percent cover
22. The population has certain attributes which an organism or individual does not. These are
- Birth rate
 - Death rate
 - Sex ratio
 - Age distribution
- i and ii
 - ii and iii
 - iii and iv
 - i, ii, iii and iv
23. The reason of the altitude sickness is
- The low atmospheric pressure of high altitudes
 - The high atmospheric pressure of high altitudes
 - The low atmospheric temperature of high altitudes
 - Both (a) and (b)
24. A person experience altitude sickness when they go to any high place like Rohtang pass near Manali and Mansarovar in China occupied Tibet, above a height
- > 3500 m
 - > 3500 feet
 - > 500 m
 - > 500 feet
25. Read the following statements and find out the incorrect statement
- Mango tree do not and cannot grow in tropical countries like Canada and Germany
 - Snow leopards are not found in kerala forests
 - Tuna fish are rarely caught beyond tropical latitudes in the ocean
 - Both (a) and (c)
26. Though it is energetically expensive, tobacco plant produces nicotine because
- It increases the taste of tobacco leaves
 - It stimulates the secretion of adrenaline
 - It decreases transpiratory water loss
 - It protects it from herbivores
27. Why does a bird sing?
- Operating of the voice box
 - Vibrating
 - Bird needs to communicate with its mate during breeding season

- (d) Both (a) and (b)
- 28.** Which of the following organisms are indeed capable of thermoregulation and osmoregulation?
- All birds
 - All mammals
 - Very few lower vertebrate and invertebrate species
 - All the above
- 29.** The adjustment of pupil of our eye to light intensity is an example of
- Eutropy
 - Steady state
 - Adaptation
 - All of these
- 30.** An ecosystem resists change because it is in a state of
- Imbalance
 - Homeostasis
 - Shortage of light
 - Deficiency of light
- 31.** A high density of Elephant population in an area can result in
- Predation on one another
 - Mutualism
 - Intraspecific competition
 - Interspecific competition
- 32.** Two opposite forces operate in the growth and development of every population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
- Fecundity
 - Mortality
 - Environmental resistance
 - Biotic control
- 33.** Which plant is found in mangrove zone?
- Rhizophora
 - Acacia
 - Pinus
 - Tectona grandis
- 34.** In an animal population of 1,000 individuals showing exponential growth, birth rate is 0.15 per capita per year and death rate is 0.10 per capita per year. What will be the population size after 10 years? ($e=2.72$)
- 1,500
 - 1,649
 - 1,964
 - 7,398
- 35.** During a study, a team of students captured 35 snails from a garden. They marked their shells with nail polish and released them back into the garden. A week later, they randomly

captured 24 snails from the garden, of which 12 were marked. What is the total number of snails in the pond?

- (a) 38 (b) 60 (c) 80 (d) 70

- 36.** Verhulst-Pearl Logistic Growth is described by the equation

- (a) $\frac{dN}{dt} = rN \left[\frac{K-N}{K} \right]$ (b) $\frac{dN}{dt} = rN$
 (c) $\frac{K-N}{K}$ (d) $N_t = N_0 e^{rt}$

ANSWER KEY

Strategies For Enhancement In Food Production (Animal Breeding)

1. a 2. c 3. b 4. b 5. c
 6. a 7. b 8. d 9. b 10. b

Organisms and Population

1. a 2. a 3. d 4. c 5. b
 6. c 7. d 8. a 9. d 10. c
 11. b 12. a 13. c 14. a 15. b
 16. b 17. c 18. b 19. c 20. d
 21. c 22. d 23. a 24. a 25. a
 26. d 27. c 28. d 29. c 30. b
 31. c 32. c 33. a 34. b 35. d
 36. a

HINTS & SOLUTIONS

Strategies For Enhancement In Food Production (Animal Breeding)

1. (a) When an animal population is subjected to cross breeding Heterozygosity and fitness are increased.
2. (c) Outcross is an individual produced from mating between same breed and not closely related individuals.
3. (b) Reduced fertility and productivity in animals due to continued inbreeding can be overcome by mating animals within same breed but having no common ancestors for up to 4-6 generations.

- 4.** (b) Multiple ovulation embryo transfer technology (MOET) is a controlled breeding experiment.

- 5.** (c) Four important species of honeybee utilised in apiculture are: *Apis mellifera*, *Apis indica*, *Apis dorsata*, *Apis florea*

- 6.** (a) Arrhenotoky is a form of parthenogenesis in which unfertilized eggs develop into males.

- 7.** (b) Statement A and D are related to agriculture and are completely unrelated to dairy management.

- 8.** (d)

- 9.** (b)

- 10.** (b)

Organisms and Population

- 1.** (a)
2. (a) Regulators are those organisms which regulate a constant body temperature
3. (d) Thermoregulation is energetically expensive process for many organisms. This is particularly true for small animals like shrews and hummingbirds. Heat loss or heat gain is a function of surface area. Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions.

- 4.** (c) The organism can migrate away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over.

- 5.** (b)

- 6.** (c)

- 7.** (d)

- 8.** (a) According to Exponential growth equation:

$$N_t = N_0 e^{rt}$$

where, N_t =Population density at time t.

N_0 = Population density at time zero

r = Intrinsic rate of natural increase

e =Base of natural Logarithms (2.718)

t = 3 years

Now, present population density = x

Population density after 2 yrs= $2x$

So, $2x = xe^{3r}$

Applying log on both sides

$$\Rightarrow \log 2 = 3r \log e$$

$$\Rightarrow \frac{\log 2}{3 \log e} = r$$

$$\Rightarrow \frac{\log 2}{3 \times 0.434} = r$$

$$\Rightarrow 0.2311 = r$$

- 9.** (d) The death rate in the population during that period is $4/40 = 0.1$ individuals per fruitfly per week.

$$\begin{aligned} \frac{dN}{dt} &= rN \left(\frac{K-N}{K} \right) \\ 10. (c) \quad &= 0.15 \times 1200 \left(\frac{2000-1200}{2000} \right) \\ &= 180 \left(\frac{800}{2000} \right) = 80 \left(\frac{2}{5} \right) \\ &= 72 \end{aligned}$$

- 11.** (b) Predator & Prey both evolve to achieve their goals.

- 12.** (a) Bacterial growth curve shows lag, log, stationary and decline phase.

- 13.** (c) Exponential equation

$$dN/dt = (b-d) \times N$$

$$dN/dt = (0.036 - 0.016) \times 14$$

$$= 0.020 \times 14$$

$$dN/10 = 0.28$$

$$dN = 0.28 \times 10$$

$$dN = 2.8$$

So, $14 \text{ million} + 2.8 \text{ million} = 16.8 \text{ million}$

- 14.** (a) Phytophagous insects feed on plant sap and other parts of the plants. Nearly 25% of the insects belong to this group and it is estimated to be approximately 5,00,000 insects.

- 15.** (b) Competitive release is a situation in which an organism is relieved of the stresses associated with competition.

- 16.** (b) Overlapping of niches of two species

results in competition, which may lead to competitive exclusion. Competitive exclusion may be avoided if the competing species evolves to use different resources, occupy different areas of the habitat, or feed during different time of day. Mac Arthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.

17.(c) In competition, organisms use up resources directly. Once used, the resource is no longer available for other species to use. In interference competition, one organism prevents other organisms from using the resource.

18.(b) Newly invaded exotic species will not be having its natural predator hence, it multiplies at a faster rate

19. (c) Euryhaline organisms can tolerate wide range of salinities.

20.(d) Intestinal symbionts exist inside our body. There is no availability of oxygen hence, they are not able to perform aerobic respiration.

21.(c) In case of Parthenium plants and banyan tree, the percent cover or biomass is a more meaningful measure of the population size.

22.(d) Population is a group of individuals of same species living together in a habitat, which have certain characteristic like birth rate, death rate, age distribution and sex ratio.

23.(a) At high altitudes there will be low atmospheric pressure

24.(a) Altitude sickness is also called acute mountain sickness. It is a negative health effect on high altitudes above 3500m.

25.(a)
26. (d) The problem of predation is particularly severe for plants because, unlike animals, they cannot run away from their predators. Therefore, plants have morphological and chemical defences against herbivores. Many plants produce and store chemicals

that make the herbivore sick when they are eaten, inhibit feeding or digestion, disrupt its reproduction or even kill it. Examples: cardiac glycosides, nicotine, caffeine, quinine, strychnine, opium.

27. (c)

28. (d)

29. (c) The pupil is an opening that lets light into your eye. Since most of the light entering your eye does not escape your pupil appears black. In dim light your pupil expands to allow more light to enter your eye, in bright light it contracts.

30.(b) Homeostasis is a state of maintaining a constant environment inside our body.

31.(c) Intraspecific competition is the competition occurring between the same species hence there will be more number of same species in an area.

32.(c) The environmental factors which can check the growth population size constitute the environmental resistance.

33.(a) Rhizophore is a genus of Tropical mangrove trees.

34. (b) $r = (b-d) = 0.15-01$

$$= 0.05$$

$$N_t = N_0 e^{rt}$$

$$= 1000 \times 2.72^{0.05 \times 10}$$

$$= 1000 \times 2.72^{0.5}$$

$$= 1000 \times \sqrt{2.72}$$

$$= 1000 \times 1.649 = 1649$$

35.(d) Mark and recapture method is used to estimate population size of animals.

$$\frac{\text{Number marked in the first catch (M)}}{\text{Total population (N)}} = \frac{\text{Number marked in the second catch (m)}}{\text{Total number of second catch (n)}}$$

$$\frac{M}{N} = \frac{m}{n}$$

$$N = \frac{m}{n} \times \frac{35 \times 24}{12} = 70$$

36. (a)

CLASS
XI

BIOLOGY KVPY-7

PREVIOUS YEAR QUESTIONS

Animal Kingdom

1. If birds are moved from 30°C to 10°C, their body temperature: [2009]

- (a) Changes from 30°C to 10°C,
- (b) Increases by 10°C
- (c) Does not change at all
- (d) Decreases by 10°C

2. Unlike humans, dogs cannot perspire to get rid of excess metabolic heat. They lose metabolic heat by: [2009]

- (a) Panting
- (b) Running in windy conditions
- (c) Taking a bath
- (d) Rolling in the mud

Cell-The Unit of Life

1. Proteins are synthesized on: [2009]

- (a) Cytoskeleton
- (b) Mitochondria
- (c) Ribosomes
- (d) Golgi apparatus

2. If the analogy of a city is applied to a eukaryotic cell then which of the following statements is correct? [2008]

- (a) Nucleus as a library and mitochondria as powerhouse
- (b) Nucleus as a police station and mitochondria as powerhouse
- (c) Mitochondria as powerhouse and golgi as a cargo sorting facility
- (d) Mitochondria as powerhouse and nucleus as slaughter house

3. You have a tube containing 10^2 bacteria. You have taken out 10^2 bacteria. How many bacteria are left in the tube? [2008]

- (a) Approximately 10^7
- (b) Approximately 10^6
- (c) Approximately 10^5
- (d) Approximately 10^9

Biomolecules

1. Ascorbic acid is a/an

- (a) Strong inorganic acid
- (b) Hormone
- (c) Vitamin
- (d) Enzyme

2. You are synthesizing a 5 amino acid containing peptide from the pool of 20 standard amino acids by choosing amino acids randomly. What is the probability of selecting Gly-Gly-Gly - Gly [2008]

- (a) 0
- (b) $1/20^5$
- (c) $1/20$
- (d) $1/(20 \times 5)$

3. On a normal sunny day, rate of photosynthesis (per unit time) is maximum during : [2007]

- (a) Early morning
- (b) Between late morning to before noon
- (c) Midday
- (d) Late evening

Photosynthesis in Higher Plants

1. During photosynthesis, light energy: [2007]

- (a) Is converted to chemical energy
- (b) Is converted to kinetic energy
- (c) Is the catalyst
- (d) Dissociates CO_2 directly

Plant Growth & Development

1. Seedling grown in dark are: [2009]

- (a) Similar to those grow in light
- (b) taller than those grow in light
- (c) Shorter than those grow in light
- (d) They don't grow at all

2. If you put a nail at the middle of a young plant and allow it to grow, then: [2007]

- (a) You will find the nail at the same position after the tree is fully grown
- (b) The nail will fall out

- (a) Lymphoma (b) Leukemia
 (c) Prostate cancer (d) Oral cancer
3. A patient given broad spectrum antibiotic suffered from vitamin deficiency because: [2007]
- (a) Antibiotic inactivated the vitamins
 (b) Antibiotic inhibited the synthesis of vitamins
 (c) Antibiotic killed the commensals in the gut which produced vitamins
 (d) Antibiotics killed the vitamin producing cells in liver
4. In a wound 'pus' is a: [2007]
- (a) A mixture of destroyed germs, killed leucocytes and damaged tissue cells
 (b) Concentrated blood plasma
 (c) Thick mucus secretion
 (d) Concentrated secretion of the sebaceous gland
5. Which of the following is a bacterial disease? [2007]
- (a) Smallpox (b) Measles
 (c) Meningitis (d) Rabies

Strategies for Enhancement in Food Production (Animal Breeding)

1. In warmer weather, curds from milk forms faster because: [2009]
- (a) Bacteria diffuse better in warmer milk
 (b) The rate of bacterial multiplication increases
 (c) Lactogen is better dissolved
 (d) It is easier to separate protein from water
2. Majority of the world population depends largely on the following for their staple food: [2007]
- (a) Fungi and algae
 (b) Animal products
 (c) Dicotyledenous
 (d) Monocotyledenous plants

Biodiversity & Conservation

1. Use of an insecticide in an island made a certain insect species extinct. A few years later a tree species was also found to be extinct. This may be because: [2008]

- (a) The tree is pollinated by the insect
 (b) The insect used to live on the tree
 (c) The insect used to eat the leaves of the tree
 (d) The tree is insectivorous

Organisms & Population

1. Similar type of vegetation can be observed, in the same? [2009]
- (a) Latitude (b) Longitude
 (c) Country (d) Continent

Ecosystem

1. Which of the following ecological food chain does not represent an erect pyramid of numbers? [2009]
- (a) Grass-rodent-snake
 (b) Tree-bird- avian parasite
 (c) Grass-deer -Tiger
 (d) Insect-chicken-Human

Miscellaneous

1. If you are asked to write on a topic of interest, you can read as many books as you want but never copy someone else's writing on the same topic. The act is called plagiarism and is morally incorrect, as: [2007]
- (a) You are stealing someone else's labor
 (b) It is a punishable offence in cancer
 (c) You have not paid money to do so
 (d) A patent exists on the writing

ANSWER KEY

Animal Kingdom

1. c 2. a

Cell-The Unit of Life

1. c 2. c 3. b

Biomolecules

1. c 2. b 3. b

Photosynthesis in Higher Plants

1. a

Plant Growth & Development

1. b 2. a

Respiration in Plants

1. c

Mineral Nutrition

1. c

Locomotion & Movement

1. d

Digestion & Absorption

1. b 2. a 3. d 4. a, c 5. c

Body Fluids & Circulation

1. c 2. d 3. a 4. d

Excretory Products & Their Elimination

1. a

Neural Control Coordination

1. d 2. a 3. c

Chemical Coordination & Integration

1. d

Principles of Inheritance & Variation

1. c 2. a

Human Reproduction

1. c

Evolution

1. b 2. c

Human Health & Diseases

1. d 2. b 3. c 4. a 5. c

Strategies for Enhancement in Food Production (Animal Breeding)

1. b 2. d

Biodiversity & Conservation

1. a

Organisms & Population

1. a

Ecosystem

1. b

Miscellaneous

1. a

HINTS & SOLUTIONS

Animal Kingdom

- 1.Sol:** Thermoregulation is the ability of an organism to keep its body temperature within certain limits, even when the surrounding temperature is very different. Thus, the ability to maintain a high and constant body temperature enables birds to exploit a remarkable range of habitats.
- 2.Sol:** Dogs use body insulation and evaporative mechanisms, such as sweating and panting to regulate their body temperature.

Cell-The Unit of Life

- 1.Sol:** Ribosomes are the site of protein synthesis in a cell. Hence it is called protein factory.
- 2.Sol:** If cell is considered as an analogy of a city then, mitochondria can be considered as the powerhouse supplying power or energy whereas, Golgi apparatus can be considered as the cargo sorting facility as it facilitates the transport of proteins and necessary nutrients to other parts of the cell.
- 3.Sol:** All bacteria have certain generation time where they produce new cells. In this question there is no time given. Data insufficient.

Biomolecules

- 1.Sol:** Vitamin C is also known as ascorbic acid.
- 2.Sol:** Since, there are 20 essential amino acids that code for DNA codons hence the probability of selecting glycine would be 1/205.
- 3.Sol:** The main factors affecting rate of photosynthesis are light intensity, carbon dioxide concentration and temperature. The net photosynthetic rate under natural sunlight intensity increases from sunrise, reaches a maximum at mid-morning, and then shows midday depression.

Photosynthesis in Higher Plants

1.Sol: During photosynthesis the light energy from the sun is converted to chemical energy which is stored in the form of starch.

Plant Growth & Development

1.Sol: The stems of plants raised in the dark elongate much more rapidly than normal, this phenomenon is called etiolation.

2.Sol: The nail will remain at the same position after the tree is fully grown because the growth in plants occurs on the apical region or apex of the stem where the meristematic cells are found.

Respiration in Plants

1.Sol: Plants produce carbon dioxide all the time because of respiration, but during the day (when there is light), they use CO_2 for photosynthesis, and fix CO_2 into other molecules, giving as end product O_2 more than CO_2 .

Mineral Nutrition

1.Sol: Crop rotation helps to replenish nutrients to the soil. A traditional element of crop rotation is the replenishment of nitrogen through the use of green manure in sequence with cereals and other crops.

Locomotion & Movement

1.Sol: Muscle fatigue and soreness in the muscles during intense exercise like swimming or running is a result of lactic acid build up.

Digestion & Absorption

1.Sol: Bile salts help with the digestion of fats in our bodies. They solubilize the ingested fat and fat-soluble vitamins, facilitating their digestion and absorption.

2.Sol: Dietary fiber consists of plant components such as cellulose, inulin, lignins, chitins, pectins, beta-glucans, etc.

3.Sol: Sugar candy is sugar which is a carbohydrate. Digestion of carbohydrates starts in the mouth itself with the help of saliva.

4.Sol: Dietary carotenoids are thought to provide health benefits in decreasing the risk of disease, particularly certain cancers and eye disease. Carotenoids are some of nature's best antioxidants.

5.Sol: The liver has a remarkable capacity to regenerate after injury. Thus, even after partial removal, the hepatic mass is back to the state to what it was prior to surgery.

Body Fluids & Circulation

1.Sol: Eating foods that contain saturated fats raises the level of cholesterol in the blood.

High levels of Low Density Lipoprotein cholesterol in blood increases the risk of heart disease.

2.Sol: Since, 'O' blood does not have A or B antibodies on the surface of the cells they do not clump when either antiserum A or B is added.

3.Sol: Rhesus (Rh) factor is an inherited protein found on the surface of red blood cells.

Problem occurs when father is Rh positive and mother is Rh negative then the second pregnancy has chances of miscarriage.

4.Sol: Arteries don't require valves because pressure from the heart is so strong that blood is only able to flow in one direction. Whereas, Veins carry the blood back to the heart.

Excretory Products & Their Elimination

1.Sol: Haemodialysis is a way of cleansing the blood of toxins, extra salt and fluids through a dialysis machine. It is used when kidneys fail.

Neural Control Coordination

1.Sol: The cornea provides 65-75% of an eye's focusing power. Light enters the eye through the transparent cornea and passes through the pupil at the centre of the iris.

2.Sol: The cerebrum is the largest part of the brain. It is responsible for memory, speech,

the senses, and emotional response.

3.Sol: Since spinal cord is a part of nervous system, hence its injury may affect the reflex actions like sneezing.

Chemical Coordination & Integration

1.Sol: In animals, hormones are secreted by endocrine glands which are directly poured into the blood stream.

Principles of Inheritance & Variation

1.Sol: Alleles are different forms of the same gene. Some genes have a variety of different forms, which are located at the same position,

2.Sol: The probability of getting a boy again is 50% similarly, probability of getting a girl is also 50%.

Human Reproduction

1.Sol: The placenta is an organ formed during embryonic development. It is a tissue formed with the help of both maternal and foetal tissues.

Evolution

1.Sol: Charles Darwin also known as the father of evolution, wrote the book "On the origin of species".

2.Sol: Archaeopteryx is a Jurassic fossil bird that shares both bird and reptile features. It is considered as a connecting link between reptiles and birds.

Human Health & Diseases

1.Sol: Nearly all ulcers are caused due to a bacterium called Helicobacter pylori. Thus, treating H. pylori with antibiotics has lots of benefits.

2.Sol: Leukemia is cancer of the blood. It does not usually form solid tumors.

3.Sol: The use of antibiotics has long been linked to deprivation of gut bacteria. These beneficial bacteria get killed when antibiotics are administered and thus the supply of vital vitamins is obstructed.

4.Sol: Pus is a whitish-yellow, yellow, or brown-yellow protein-rich fluid called liquor puris that accumulates at the site of an infection. It consists of a build-up of dead, white blood cells that form when the body's immune system responds to the infection.

5.Sol: Meningitis is an inflammation or swelling of the protective membranes covering the brain and spinal cord. The most common causes of meningitis are bacterial infections.

Strategies for Enhancement in Food Production (Animal Breeding)

1.Sol: During summers it is very easy to set curd and it usually sets within 2 to 3 hours this is because bacteria multiply faster in warm temperature.

2.Sol: The true grasses, family Poaceae (or, Gramineae), are the most economically important family in the monocotyledonous group. Monocot seeds include grasses, such as corn and rye, and grains such as wheat and rice.

Biodiversity & Conservation

1.Sol: In an ecosystem, all organisms have a definite role to play. Insects are important as they bring about pollination. So if a particular pollinating species is wiped off from the ecosystem, then it will affect the life of the plant also, which in due course of time may also get extinct.

Organisms & Population

1.Sol: Vegetation is generally same in same latitudes.

Ecosystem

1.Sol: In tree ecosystem the pyramid of number is intermediate. Here the number of primary consumers is more than producers as well as top consumers.

Miscellaneous

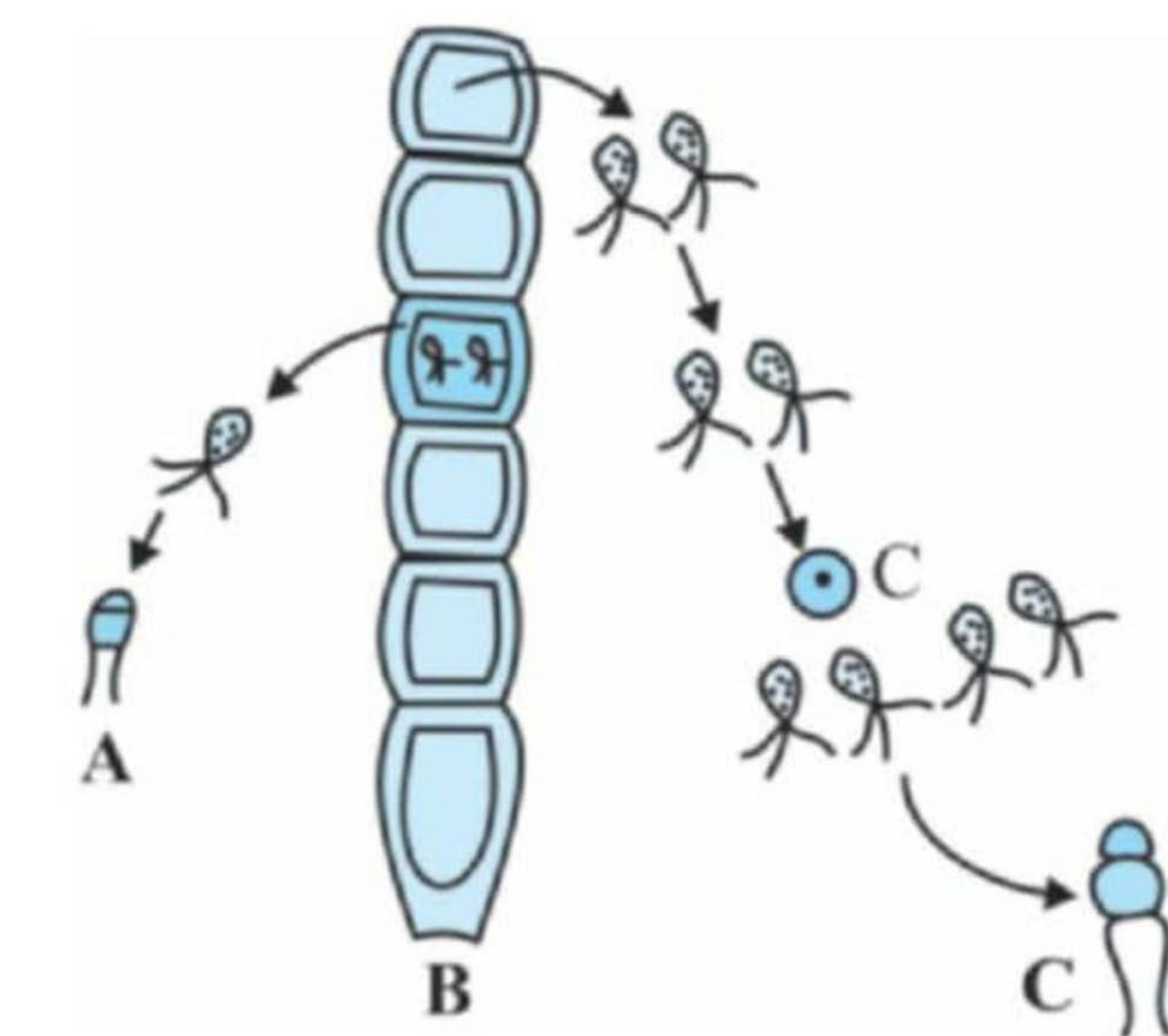
1.Sol: Plagiarism is the practice of taking someone else's work or ideas and passing them off as one's own.

NSE - BIOLOGY

CLASS X



- A strain of motile Gram positive bacterium, when treated with lysozyme, lost its pathogenicity. The virulence of the bacterium is most likely due to
 - (a) Flagellum
 - (b) Cell membrane
 - (c) Cell wall
 - (d) Pili
- Which statement is true only for organisms belonging to the kingdom -Fungi?
 - (a) They are multicellular and photosynthetic
 - (b) They have cell walls and reproduce by seeds
 - (c) They have filamentous growth and cell walls made of chitin
 - (d) They have roots and starch is the main storage molecule
 - (e) They have numerous cellular organelles, but only one nucleus per cell
- The characteristics of phylum-Rotifera, Nematoda and platyhelminthes are
 - (a) Bilateral symmetry, pseudocoelomate complete or sac- like digestive tract
 - (b) Bilateral symmetry, acoelomate, greatly reduced digestive tract
 - (c) Bilateral symmetry, coelomate/ acoelomate,complete digestive tract
 - (d) Radial symmetry, pseudocoelomate, no digestive tract
- Which of the following is not found in the phylum-Choradata?
 - (a) Bilateral symmetry
 - (b) An extranal skeleton
 - (c) A dorsal hollow nerve chord
 - (d) Gill slits at some stage during development
- Life cycle of Ulothrix shown in the diagram. The correct ploidy levels at the four stages A, B, C and D are :



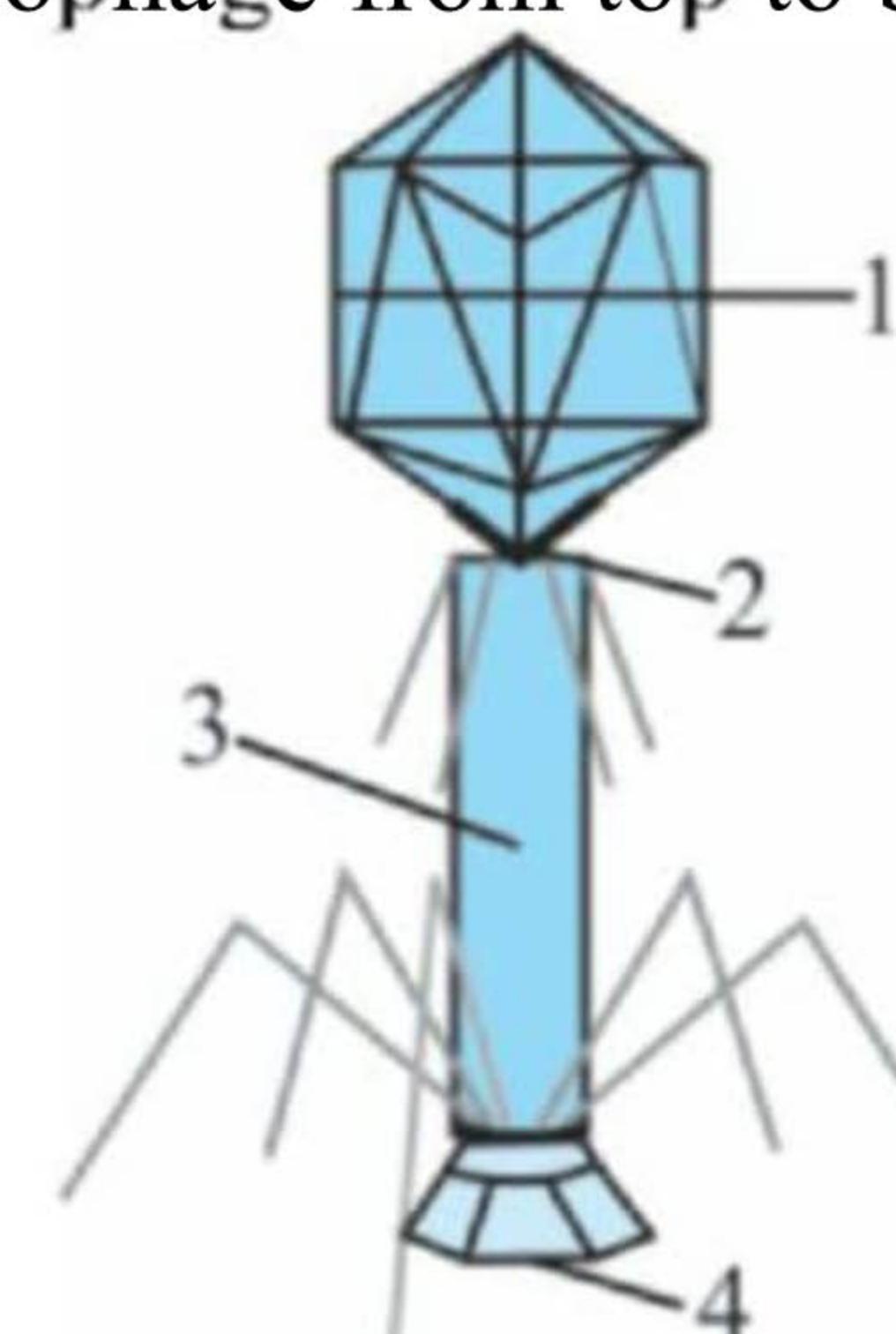
- (a) A-n B-n C-2n D-n
 - (b) A-n B-n C-2n D-2n
 - (c) A-2n B-n C-2n D--n
 - (d) A-n B-n C-n D-n
- Which of the following is not in the phylum- Mollusca (molluscs)?
 - (a) Clam
 - (b) Oyster
 - (c) Shrimp
 - (d) Snail
 - Which of the following is true about the photosynthetic protista?
 - (a) Dinophyta often have cell wall made up of armour plates
 - (b) Bacillariophyta are commonly found as phytoplankton
 - (c) All of them have chlorophyll
 - (d) All of the above
 - Which of the following is true of alternation of generation?
 - (a) The sporophyte undergoes syngamy to produce spores
 - (b) The sporophyte undergoes meiosis to produce spores
 - (c) The gametophyte undergoes syngamy to produce spores

(d) The gametophyte undergoes meiosis to produce gametes

- Air bladder is
 - (a) A respiratory organ in birds
 - (b) Excretory organ in Mammals
 - (c) A cnidarian
 - (d) A hydrostatic organ in bony fishes

- The principle pigment imparting distinctive brown or olive brown colouration to the thallus of phaeophyta is
 - (a) sinphonaxanthin
 - (b) fucoxanthin
 - (c) necoxanthin
 - (d) flavoxanthin

- Mark the correct labelling in the T4 bacteriophage from top to bottom.



- (a) Collar, head, tail, endplate, tail fibre
- (b) Head, collar, tail, endplate, tail fibre
- (c) Head, endoplase, tail, collar, tail fibre
- (d) Head, collar, tail, endoplase, tail fibre

- The top five crops, as on date, in terms of annual world production in millions of metric tonnes belong to the families.
 - (a) Gramineae and Solanaceae
 - (b) Gramineae and Cruciferae
 - (c) Gramineae and Leguminosae
 - (d) Leguminosae and Cucurbitaceae

- One of the following is not a feature of amphibians
 - (a) Habitate-damp places
 - (b) Egg - laying in water
 - (c) Scaly skin
 - (d) larvae respire by gills

- The numbered items corresponding with those marked with letters are

- | Column I | Column II |
|-----------------|---------------------|
| A. Green algae | 1. Floridean starch |

- | | |
|--------------------------------|----------------|
| B. Brown algae | 2. Frustules |
| C. Red algae | 3. Prokaryotic |
| D. Golden brown or green algae | 4. Mannitol |
| | 5. Gemma |
| | 6. Starch |

- Codes:**
- | | |
|-------------|-------------|
| A B C D | A B C D |
| (a) 6 4 2 5 | (b) 6 3 2 4 |
| (c) 5 4 1 2 | (d) 6 4 1 2 |

- Match the following structures of a sponge with their respective functions and mark your answer from the code given below

Column I	Column II
A. Amoebocyte	1. Controle of water entry
B. Epidermal cell	2. Movment of water and filter of food
C. Collar cells	3. Skeletal support element
D. Spicules	4. Transport of food to non feeding cells

- Codes:**
- | | |
|-------------|-------------|
| A B C D | A B C D |
| (a) 1 3 4 2 | (b) 3 2 1 4 |
| (c) 4 1 2 3 | (d) 2 4 3 1 |

- Monotremes are unique mammals because they
 - (a) Possess hair
 - (b) give birth to live young
 - (c) secrete milk in a pouch
 - (d) lay eggs
 - (e) possess a bill

- Which of the following is present in the respiratory system of insects, fish and mammals?
 - (a) Blood containing oxyhaemoglobin
 - (b) Alveoli
 - (c) Spiracles
 - (d) A thin moist surface

- Which of the following correctly ranks the following structures in terms of size, from smallest to largest? Virus particle(VP), algal cell (AC), water molecule (WM), chloroplast (CH), phospholipid molecule (PM).
 - (a) WM-PM-VP-CH-AC
 - (b) VP-WM-CH-PM-AC
 - (c) WM-VP-PM-AC-CH

(d) PM-WM-VP-CH-AC

19. The gymnosperms differ from the ferns in that

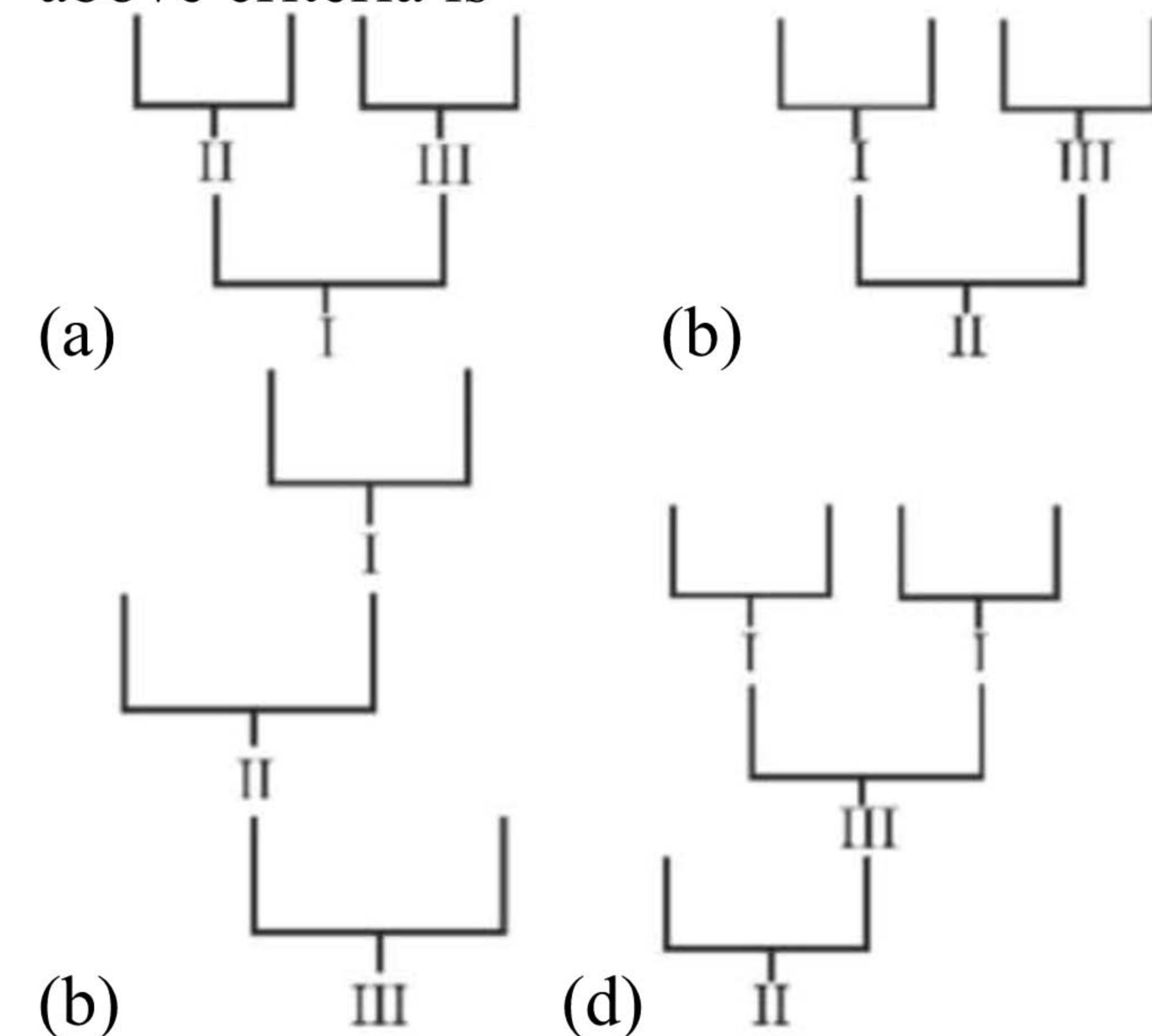
- (a) Sexual fusion does not occur in water
- (b) They have vascular tissue
- (c) They have a large gametophyte
- (d) They produce gymnospores

20. Some criteria for classifying animals are

- I. Presence or absence of coelom
- II. Presence or absence of true tissue organization.

- III. Presence of 2 or 3 tissue layers.

The correct way of classification using the above criteria is



21. Pick out the correct answer by using the codes given below. Mycorrhizal association is obligatory for growth in

- I. Formation of apothecia in lichens
- II. Growth of gametophytes in some species of *Lycopodium*.

- III. Growth of coralloid roots of cycas.

- IV. Germination of the seeds of Orchidaceae.

- (a) I and III (b) II and IV
- (c) II and III (d) III and II

22. Whirling whipes are protists which possess two flagella that beat

- (a) Slightly towards one side so as to cause rotation of the organism while moving forward
- (b) Forward, backward and sideways depending upon the requirement
- (c) At right angle to each other due to being present in different grooves

(d) Along with numerous cilia

23. Pick up the properly matched

- (a) Arthropoda-Arachnida- Lobster
- (b) Arthropoda- Myriapoda-Scorpion
- (c) Mollusca-Cephalopoda-*Octopus*
- (d) Mollusca-Gastropoda-Squid

24. Which of the following groups contain organisms that are most closely related?

- (a) *Rhizobium*, *E.coli* and *Salmonella*
- (b) *Mangifera indica*, lizard and *Mucor*
- (c) *Amoeba*, yeast and fern
- (d) Jelly fish, cat fish and whale

25. Match the following and mark the correct answer from the codes given below.

Column I	Column II
(Division of algae)	(Reserve food materials)
A. Cyanophyta	1. Chrysolaminarin
B. Chlorophyta	2. Amylopectin
C. Phaeophyta	3. Floridean starch
D. Rhodophyta	4. Starch
	5. Laminarin

Codes:

A	B	C	D
(a) 2	4	5	3
(b) 2	5	1	3
(c) 2	3	5	1
(d) 1	4	3	5

26. Following are given some statement about bryophytes. Mark the incorrect statement

- (a) Gametophyte is dominant generation in all bryophytes
- (b) Sporophytes is always haploid
- (c) Sporophyte is dependent on gametophyte for nutrition
- (d) Water and minerals are absorbed by the whole plant

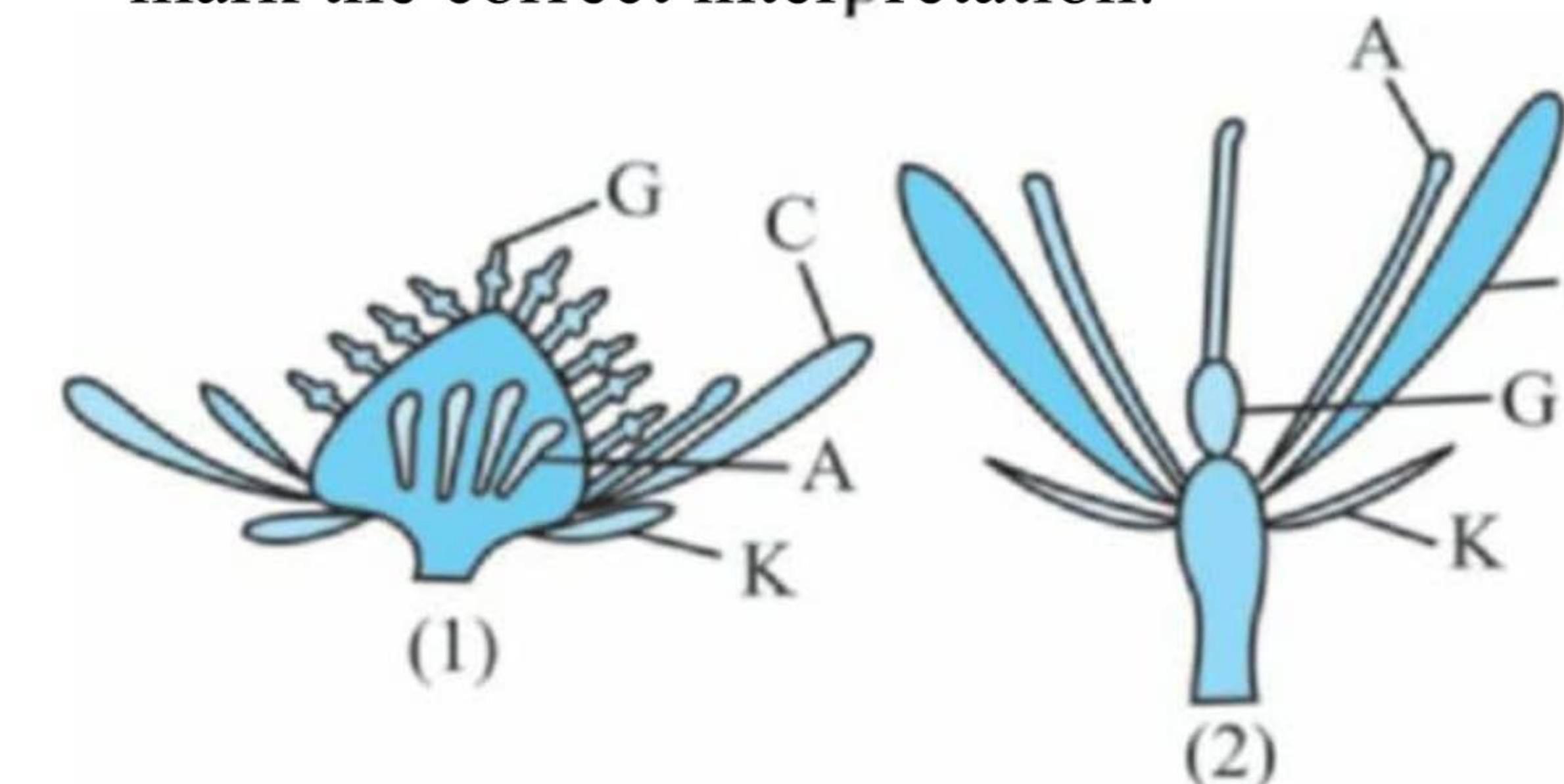
27. Placement of gymnosperms between dicotyledons and monocotyledons is one of the drawbacks in the system of classification of

- (a) Rendle
- (b) Bentham and Hooker
- (c) Engler and Prantl
- (d) Linnaeus

28. Which statement is false?

- (a) Bacteria are necessary for the decomposition
- (b) Bacteria can cause diseases of plants
- (c) Bacteria are part of your 'personal' microflora
- (d) Bacteria are necessary for biological nitrogen fixation
- (e) Bacteria are necessary for photosynthesis

29. Two flower structure are shown in the figure. mark the correct interpretation.



- (a) 1 is primitive and 2 is advanced
- (b) 1 is advanced and 2 is primitive
- (c) Both are advanced flower structures
- (d) Both are primitive flower structures

30. Which of the following is not an Indian carps?

- (a) *Catla catla*
- (b) *Labeo rohita*
- (c) *Cirrhinus mrigala*
- (d) *Cyprinus carpio*

31. Which of the following has both endoskeleton as well exoskeleton?

- (a) Cockroach
- (b) Sponge
- (c) Snake
- (d) Frog

32. Which of the following are true *Peripatus*?

- I. It is a connecting link between Annelida and Arthropoda
 - II. It is a connecting link between Arthropoda and Mollusca
 - III. It is living fossil.
 - IV. It is endemic to South America.
- (a) I,II and III
 - (b) I and III
 - (c) II and III
 - (d) III and IV

33. Agnatha or Cyclostomata are characterized by

- (a) Absence of jaws and presence of suctorial mouth
- (b) Presence of suctorial mouth, absence of jaws, presence of single nostril and unpaired fins

- (c) Absence of mouth, presence of single nostril
- (d) Round mouth with triradiate lips

34. An archegonium of *Riccia* has

- (a) 4 neck canal cells, 1 venter canal cell and 1 oosphere
- (b) 4 neck canal cells, 2 venter canal cell and 1 oosphere
- (c) 4 neck canal cells, 1 venter canal cell and 2 oospheres
- (d) 6 neck canal cells, 2 venter canal cells and 1 oosphere

35. A plant from Liliaceae whose underground stem yields a chemical mutagen, which produces polyploids by hindering the spindle formation. Which is the plant?

- (a) *Solanum tuberosum*
- (b) *Nicotiana tabacum*
- (c) *Parthenium hysterophorous*
- (d) *Colchicum autumnale*

36. Which important aspect of the classification of all organisms is attributed to Carl Linnaeus?

- (a) The use of Latin
- (b) The use of branching diagrams (trees) to depict relationships among groups
- (c) The use of standardized common names
- (d) The use of two-parts names (binomials)
- (e) The use of keys for identification

37. It is generally agreed that prokaryotes constituted the first life on earth. It is also generally accepted that the early eukaryotes were

- (a) Photosynthetic
- (b) Chemosynthetic
- (c) Heterotrophs
- (d) Multicellular
- (e) Unicellular

38. Which statement is false?

- Bacteria are involved in
- (a) animal diseases
 - (b) decomposing dead organic matter
 - (c) nitrogen processing in the soil
 - (d) food digestion in animals
 - (e) alcohol production in beer

39. The endosperms of an angiosperm differ from that of a gymnosperm in that it

- (a) Is triploid
- (b) Only lasts a few days
- (c) Does not form until fertilization takes place
- (d) Both (a) and (c)

40. Which of the following animals is not a mammal?

- (a) Bird (b) Kangaroo
- (c) Dog (d) Human
- (e) *Echidna*

41. Both algae and fungi are not independently capable of initiating seral change on bare rocks but lichens can do so because they

- (a) Adapt suitably to xeric conditions
- (b) Are a combination of algae and fungi
- (c) Can secrete acids causing weathering of rocks
- (d) do not require much moisture for growth

42. Two different animals are classified into the same family. This means they would be classified in

- (a) The same phylum, but different class
- (b) The same class but different species
- (c) A different kingdom and different phylum
- (d) A different class and a different order
- (e) The same genus, but different phylum

43. What group(s) of organisms are characterized by the structures shown in the diagram?



44. Which of the following descriptions does not apply to Phaeophyta?

- (a) Dominant photosynthetic pigment is fucoxanthin
- (b) Stores carbohydrates as mannitol
- (c) Nearly all are freshwater
- (d) Body is filamentous or thalloid

45. Which of the following use their own metabolic energy to maintain a near constant body temperature?

- | | |
|---------------|----------------|
| I. Fish | II. Birds |
| III. Reptiles | IV. Amphibians |
| V. Mammals | |
- (a) I, II, III, IV and V
 - (b) II, III, IV and V
 - (c) II, III and V
 - (d) II and V
 - (e) V only

46. A major difference between insect and vertebrate population is that

- (a) The insect populations are based on family unit, whereas the vertebrate society is not
- (b) There is more recognition of individuals in vertebrate rather than insect populations
- (c) Only insects display altruistic behaviour to benefit the society
- (d) Communication is absent in insect populations

47. Which of the following statements about reproduction in *paramecium* are true?

- I. Conjugation is process of sexual reproduction
 - II. Macronuclei always divide mitotically,
 - III. Conjugation is a process of only genetic recombination.
 - IV. During the process of conjugation, each paramecium gives and receives equal amount of DNA.
- (a) I, III and IV
 - (b) II and IV
 - (c) III and IV
 - (d) Both (a) and (c)

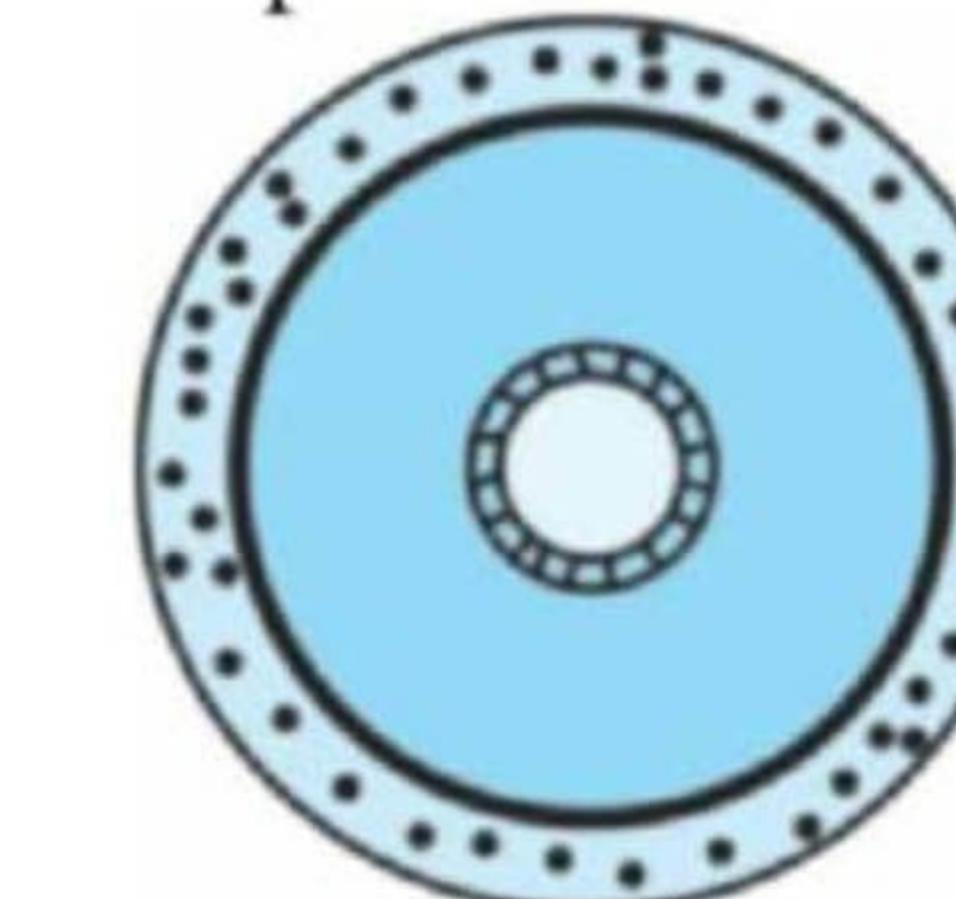
48. The Phaeophyta, Rhodophyta and Chlorophyta are distinguished by the following feature.

- (a) Their degree of multicellularity

(b) Their accessory (light-harvesting) pigments

- (c) Nuclei
- (d) All of the above

49. The figure represent the interial body plan of



- (a) Platyhelminthes
- (b) Nematoda
- (c) Annelida
- (d) Echinodermata

50. A volcano rises from the floor of the ocean. The resulting island gradually becomes populated with living organisms. The most likely order of colonization is

- (a) Blue-green algae, grass, trees, birds and snakes

(b) Birds, snakes, trees, blue-green algae and grass

- (c) Snakes, birds trees, blue-green algae and grass

- (d) Trees, grass, birds, snakes and blue-green algae

ANSWER KEY

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. c | 2. c | 3. a | 4. b | 5. a |
| 6. c | 7. d | 8. b | 9. d | 10. b |
| 11. d | 12. c | 13. c | 14. d | 15. c |
| 16. d | 17. d | 18. b | 19. a | 20. d |
| 21. b | 22. c | 23. c | 24. a | 25. a |
| 26. b | 27. b | 28. e | 29. a | 30. d |
| 31. c | 32. b | 33. b | 34. a | 35. d |
| 36. c | 37. e | 38. e | 39. d | 40. a |
| 41. d | 42. b | 43. c | 44. c | 45. d |
| 46. b | 47. d | 48. b | 49. b | 50. a |

PUZZLE SOLUTION: AUGUST MONTH ISSUE

	1 C	L	O	N	I	N	G	G	E	N	E	S
2 B	I	O	R	E	S	O	U	R	C	E	S	
	3 H 4	Y	B	R	I	D	O	M	A			
5 A 6	N	T	I	T	R	Y	P	S	I	N		
D		R				7 C						
A		U					8 P	C	R			
	9 D	O	L	L	Y							
		I										
	10 G	E	N	E	T	H	E	R	A	P	Y	
11 T	R	A	N	S	G	E	N	E	S			
							12 E	L	I	S	A	
							S					

(NES) NEET Edge Series

Microbes In Human Welfare, Biotechnology And Its Principles

Microbes In Human Welfare

- Two microbes found to be very useful in genetic engineering are
 - Agrobacterium tumefaciens* and *Caenorhabditis elegans*
 - Escherichia coli* and *Agrobacterium tumefaciens*
 - Diplococcus* and *Streptococcus*
 - Pseudomonas* and *Streptomyces*
- Arrange the following organisms in the increasing order (least important first) of their importance for the welfare of human society

i. <i>Methanobacterium</i>	ii. <i>Acetobacter aceti</i>
iii. <i>Streptomyces</i>	iv. <i>Lactobacillus</i>
(a) ii, iv, iii, i	(b) ii, iii, i, iii
(c) iv, ii, iii, i	(d) iii, i, iv, ii
- Tissue plasminogen activator is
 - an enzyme
 - Amino acid
 - A vitamin
 - a chemical that stimulate tissue differentiation
- Antibiotics are modified to enhance their potency. They are called
 - Semi synthetic antibiotic
 - Synthetic antibiotic
 - Hyper sensitive antibiotic
 - Good antibiotic
- Select incorrect statement on Antibiotics

- Because of the discovery of antibiotics in the twentieth century, a number of dreaded diseases have become infected.
- Antibiotics have saved millions of people
- A broad spectrum antibiotic destroys a number of pathogens
- Pencillin, bacitracin and cephalosporin disrupt bacterial cell wall formation
- Which of the following statements is correct?
 - Single cell protein is rich in high quality proteins but poor in fat.
 - BOD is the amount of oxygen that would be consumed if all the inorganic matter in one litre of water were oxidised by bacteria.
 - Trichoderma* sp are free living fungi that are effective biocontrol agents of several pathogens.
 - Baculoviruses are pathogens that attack insects and other arthropods.
 - Bacillus thuringiensis* is first used biopesticide.
 - Lactase enzyme is used in alcholic fermentation.
 - Mycorrhiza is a symbiotic association between fungi e.g. *Glomus* and vascular plant.

(a) ii, iii, vi, vii	(b) i, iii, iv, v, vii
(c) i, iv, vi	(d) ii, vi
- Which of the following statements about

mycorrhizae is false?

- In ectomycorrhizae, association between the fungus and plant is less intimate than in endomycorrhizae
 - The mycorrhizal association of fungus and the plant may have had importance in the evolution of land plant
 - The mycorrhizal association is a mutualistic symbiosis
 - Fungal partner is associated with the only roots of the higher plants (like angiosperms)
 - Only advanced modern plants such as angiosperms possess mycorrhizae

(a) Only iv	(b) Only v
(c) Only i and iii	(d) Only ii and v
8. Make correct pair
- | | |
|--------------------|---------------------------------|
| P. Citric acid | p. <i>Aspergillus niger</i> , |
| Q. Butyric acid | q. <i>Clostridium butyricum</i> |
| R. Proteases | r. <i>Candida lipolytica</i> , |
| S. Lipase | s. <i>Aspergillus oryzae</i> |
| (a) Pp, Qq, Rs, Sr | (b) Pp, Qq, Rr, Ss |
| (c) Pr, Qq, Rp, Sq | (d) Pg, Qr, Rs, Sp |
9. In STPs major part of sludge is pumped into large tanks called
- Anaerobic sludge digesters
 - Aerobic sludge digesters
 - Biological sludge digesters
 - None of these
10. **Column I** **Column II**
- | | |
|-------------------------|------------------|
| A. <i>Saccharomyces</i> | 1. Bacteria |
| B. <i>Trichoderma</i> | 2. Cyanobacteria |
| C. <i>Lactobacillus</i> | 3. Fungi |
| D. <i>Nostoc</i> | 4. Yeast |
- Which of the combinations is correct?
- | A | B | C | D |
|----------|----------|----------|----------|
| (a) 4 | 2 | 1 | 3 |
| (b) 3 | 4 | 1 | 2 |
| (c) 1 | 2 | 3 | 4 |
| (d) 4 | 3 | 1 | 2 |
11. What would happen if oxygen availability to activated sludge flocs is reduced?
- It will slow down the rate of degradation of organic matter
 - The center of flocs will become anoxic, which would cause death of bacteria and eventual breaking of flocs
 - Flocs would increase in size as anaerobic bacteria would grow around flocs
 - Protozoa would grow in large number
12. Activated sludge should have the ability to settle quickly so that it can
- Be rapidly pumped back from sedimentation tank to aeration tank
 - Absorb pathogenic bacteria present in wastewater while sinking to the bottom of the settling tank
 - Be discarded and anaerobically digested
 - Absorb colloidal organic matter
13. Formation of flocs means
- Association of virus with the bacterial remains in water
 - Bacteria which is associated with the mycorrhiza of the fungus of soil
 - Bacteria which is associated with the mycorrhiza of the fungus of water
 - Bacteria which is associated with the solid waste of the water
14. Enzyme immobilization is
- changing pH
 - Conversion of active enzyme into inactive enzyme
 - Conversion of inactive enzyme into active enzyme
 - Providing enzyme with protective covering.
15. Which of the following microbial organisms can be used as biocontrol agents?
- Lady bird beetle and NPV,
 - Dragon flies,
 - Bt and Gambusia fish,
 - Trichoderma* & Bt

(a) iii, iv	(b) i, ii, iii, iv
(c) i, iii, iv	(d) iv
16. Select incorrect statement regarding biocontrol agents
- Biocontrol refers to use of chemical methods for controlling plant and pest's

- (b) Biocontrol is a holistic approach that seeks to develop an understanding of the webs of interaction between the myriad organisms
 (c) Pollution can be controlled by this approach
 (d) Trichoderma is effective biocontrol agent

17. Identify incorrectly matched pair
 (a) Free living nitrogen fixing bacteria - Azotobacter
 (b) Free living nitrogen fixing cyanobacteria - Anabaena
 (c) Symbiotic nitrogen fixing bacteria - Rhizobium
 (d) Symbiotic nitrogen fixing bacteria cyanobacteria - Beijernickia

18. Which one of the following is most active nitrogen fixer of rice fields?
 (a) Aulosira fertilissima
 (b) Aulosira godoyana
 (c) Aulosira fritschii
 (d) Aulosira implexa

19. Biofertilizers include
 (a) Blue green algae, rhizobia and other N₂ fixing bacteria
 (b) Blue green algae, rhizobia and lichens
 (c) Rhizobia, other N₂ fixing bacteria and mycorrhizal fungi
 (d) Blue green algae, rhizobia and mycorrhizal fungi

20. Pollution from animal excreta and organic waste from kitchen can be most profitably minimized by
 (a) Using them for producing biogas
 (b) Using them directly as biofertilizer
 (c) Using them directly as bioinsecticide
 (d) Organic farming

21. In which case, tertiary treatment is omitted
 (a) If treated water is to be passed into rivers and streams
 (b) If treated water is to be passed into drinking water channels
 (c) If treated water is used for biogas production
 (d) In all the cases

22. Fill up blanks by selecting the correct option
 i. ----- have been commercialized as blood cholesterol lowering agent
 ii. ----- used as an immunosuppressive agent in organ transplant patients
 iii. ----- is a tissue plasminogen activator
 (a) Statins, Cyclosporin A, Streptokinase
 (b) Cyclosporin A, Statins, Chymosin
 (c) Cyclosporin A, Citric acid, Butyric acid
 (d) None of these

23. Select the correct statements from the following
 (a) activated sludge - sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria.
 (b) Biogas is produced by the activity of bacteria on animal waste
 (c) Methanobacteria is an aerobic bacterium found in rumen of cattle
 (d) Bio-gas, commonly called gobar gas, is pure methane

24. Secondary sewage treatment is mainly a
 (a) Biological process
 (b) Physical process
 (c) Mechanical process
 (d) Chemical process

25. The most abundant prokaryotes helpful to humans in making curd from milk and in production of anti biotics are the ones categorized as
 (a) Chemosynthetic autotrophs
 (b) Heterotrophic bacteria
 (c) Cyanobacteria
 (d) Archaebacteria

26. In 1928, a scientist discovered the first effective antibiotic, scientist and antibiotic are
 (a) Fleming - streptomycin
 (b) Fleming - penicillin
 (c) Waksman - penicillin
 (d) Waksman - streptomycin

27. Which one(s) is/are correct about Cyclosporin A?
 (a) It is produced by the fungus

Trichoderma polysporum

(b) It is used as an immuno suppressive agent during organ transplantation
 (c) Both (a) and (b)
 (d) It is produced by a type of yeast, Monascus purpureus

28. Which of the following statement is incorrect w.r.t. pectinases?
 (a) They are used in clearing of fruit juices
 (b) They are used in chill proofing beer and whisky
 (c) They are obtained from by *Saccharomyces* flavous
 (d) They are used in retting of fibres

29. Read the following four statements (A-4) about certain mistakes in two of them :
 i. Dough, which is used for making foods such as dosa and idli is fermented by fungi and algae
 ii. Toddy, a traditional drink of southern India is made by fermenting sap from palms
 iii. Large holes in Swiss cheese are due to production of large amount of methane by *Propioni bacterium sharmani*
 iv. In our stomach, lactic acid bacteria play very beneficial role in checking disease-causing microbes
 Which are the two statements having mistakes?
 (a) Statements (i) & (iii)
 (b) Statements (i) & (ii)
 (c) Statements (ii) & (iii)
 (d) Statements (iii) & (iv)

30. Consider the following four statements (a-d) and select the option which includes all the correct ones only,
 i. Single cell Spirulina can produce large quantities of food rich in protein, minerals, vitamins etc.
 ii. Body weight-wise the microorganism *Methylophilus methylotrophus* may be able to produce several times more proteins than the cows per day
 iii. Common button mushrooms are a very rich source of vitamin C

iv. A rice variety has been developed which is very rich in calcium.
 Options :
 (a) Statements (iii), (iv)
 (b) Statements (i), (iii) and (iv)
 (c) Statements (i), (ii)
 (d) Statements (ii), (iii) and (iv)

31. Secondary treatment of sewage
 (a) Removes grit and large pieces of organic matter
 (b) Involves shredding, chuming, filtration and sedimentation
 (c) Does not require aeration
 (d) Involves microbial digestion of organic matter

32. Select incorrect w.r.t sewage treatment plants.
 (a) in anaerobic sludge digester, gases like methane, H₂S and CO₂ are also produced.
 (b) Bacterial flocs are allowed to sediment in setting tank when BOD of sewage is high.
 (c) Primary treatment of sludge is based on sequential filtration and sedimentation.
 (d) Activated sludge is pumped into anaerobic sludge digesters to digest the bacteria and fungi

33. Besides dung, the weed which can be used in biogas production is
 (a) *Hydrilla*
 (b) *Solanum nigrum*
 (c) *Eichhornia crassipes*
 (d) *Parthenium hysterophorus*

34. Glomus is a
 (a) Cyanobacterium
 (b) Symbiotic nitrogen fixing bacterium
 (c) Endomycorrhizal fungus
 (d) Non symbiotic nitrogen fixing bacterium

35. Benefits of mycorrhizae are
 i. Resistance to root-borne pathogens
 ii. Tolerance to salinity and absorption of phosphorus
 iii. Tolerance to drought
 iv. Overall increase in the plant growth and development
 (a) only i and ii
 (b) only ii and iii

- (c) only iii and iv (d) i, ii, iii and iv
- 36.** Farmers have reported over 50% higher yields of rice by using the biofertilizer :
 (a) Mycorrhiza
 (b) Azolla pinnata
 (c) Cyanobacteria
 (d) Legume-Rhizobium symbiosis

- 37.** Which microorganism is useful to obtain short chain fatty acids?

- (a) Saccharomyces cerevisiae
 (b) Azotobacter aceti
 (c) Clostridium butyricum
 (d) Aspergillus niger

- 38.** Study the following table

i. Aspergillus niger	Afungus	Citric acid
ii. Saccharomyces	Algae	Ethanol
cerevisiae		
iii. Lactobacillus	Bacterium	Pencillin delbruchii
iv. Streptococcus	Bacterium	Clot buster sps

The correct combination is

- (a) i & ii (b) i & iv
 (c) i & iii (d) iii & iv

- 39.** Match the Column I with Column II-

Column I	Column II
A. The stage in which physical treatment of sewage is done	1. Anaerobic digestion of activated sludge and production of biogas
B. The stage in which biological treatment of sewage is done.	2. Activated sludge
C. The names of sediment and supernatant in primary treatment.	3. Aeration tanks
D. ----- is carried to aeration tanks from primary settling	4. Primary effluent
E. Site of flocs growth.	5. Primary sludge, effluent
F. Name of the sediment of	6. Secondary treatment

- secondary settling.
G. The function of Sludge digester.
 7. Primary treatment
 (a) A - 1, B - 3, C - 5, D - 7, E - 2, F - 4, G - 6
 (b) A - 7, B - 6, C - 5, D - 4, E - 3, F - 2, G - 1
 (c) A - 1, B - 2, C - 3, D - 4, E - 5, F - 6, G - 7
 (d) A - 7, B - 6, C - 1, D - 2, E - 3, F - 4, G - 5

Biotechnology And Its Principles

- 1.** Normally, the gene encoding resistance to antibiotics are considered useful selectable marker for *E. coli*
 (a) Because the normal *E. coli* cells do not carry resistance against any of these antibiotics
 (b) As it makes *E. coli* identifiable because of insertional inactivation
 (c) Because it makes *E. coli* identification through chromogenic reaction
 (d) Both (a) and (b)
- 2.** Due to ampicillin resistance gene, one is able to select a transformed cell in the presence of ampicillin. The ampicillin resistance gene in this case is called
 (a) Selectable marker
 (b) Recombinant gene
 (c) Recognition site
 (d) Origin of replication
- 3.** If a protein encoding gene is expressed in a heterologous host it is called
 (a) Primary protein
 (b) Recombinant protein
 (c) Tertiary protein
 (d) Secondary protein
- 4.** Which of the following are the parts of biotechnology?
 i. Synthesis of gene
 ii. Developing a DNA vaccine
 iii. Correcting a defective gene
 iv. In vitro fertilization
 (a) i, ii, iii and iv (b) i and ii
 (c) iii and iv (d) ii and iv
- 5.** Select the wrong statement.
 (a) DNA is a negatively charged molecule
 (b) The presence of chromogenic substrate

- gives blue colour colonies, if the plasmid in the bacteria does not have an insert.
(c) Since DNA is a hydrophilic molecule it cannot pass through cell membranes.
(d) In microinjection, cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA.

- 6.** Which is true about biotechnology techniques?
 (a) PCR is used to cut DNA molecules
 (b) A DNA probe consists of radioactive single strand of DNA
 (c) Restriction enzymes were first discovered in Bacteriophages
 (d) Pvu I is a name for a DNA probe
- 7.** If we ligate a foreign DNA at the BamHI site in pBR322, the recombinant plasmid will:-
 (a) Show ampicillin resistance only.
 (b) Show tetracycline resistance.
 (c) Grow well on tetracycline containing medium.
 (d) Not grow on ampicillin containing medium
- 8.** i. In elution the separated bands of DNA are cut out from agarose gel and extracted from the gel piece.
 ii. *E. coli* cloning vector pBR322 shows several restriction, Ori, antibiotic resistance genes and Rop.
 iii. The down stream processing and quality control testing vary from produced to product.
 iv. Competent bacterial cell cannot take up the plasmid.
 (a) All are incorrect
 (b) All are correct
 (c) Only iv is correct
 (d) Except iv all are correct
- 9.** Consider the given statements w.r.t. gel electrophoresis.
 i. DNA can be separated by forcing them to move towards cathode under an electric field.
 ii. DNA fragments separate according to

their size through sieving effect provided by agarose gel.

- iii. The used matrix in this technique is agarose which is an artificial polymer. Which of the following statements is/ are correct?

- (a) ii only (b) i and ii
 (c) i, ii, and iii (d) ii and iii

- 10.** How many fragments of DNA is obtained when a plasmid has 6 recognition sites for a restriction endonuclease and undergo digestion with the enzymes
 (a) 4 (b) 3 (c) 6 (d) 7

- 11.** What happens, when DNA fragments is inserted into plasmid (pBR-322) using enzyme Pvu-I or Pst-I ?

- i. Inactivation of ampR gene
 ii. Inactivation of tetR gene
 iii. Unable to grow in the presence of ampicillin

- iv. Unable to grow in the presence of tetracycline
 v. Unable to replicate

Mark the correct choice :-

- (a) ii and iv are correct
 (b) i and iii are correct
 (c) i, iii and v are correct
 (d) ii, iv and v are correct

- 12.** Which is incorrect?

- (a) EcoRI cuts the DNA between bases G and A.
 (b) Each restriction endonuclease recognizes a specific palindromic nucleotide sequences in DNA.

- (c) When cut by same restriction enzyme, the resultant DNA fragments do not have the same kind of 'sticky-ends'.
 (d) Making multiple identical copies of any template DNA is called cloning.

- 13.** In PCR, short primers are added to single-stranded DNA molecules in a test tube and the appropriate enzymes are included to make a copy of the DNA. Which of the following primers is needed for copying the single-stranded DNA sequence

5' TACGGTAGGTC3'?

- (a) 5'GACCT (b) 5'ATGCC
- (c) 5'GGCAT (d) 5'TACGG

14. Identify the true statements -

- i. When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of sticky ends and these can be joined together using DNA ligase
- ii. The first recombinant DNA was constructed by using a piece of DNA from a plasmid carrying antibiotic resistance gene in the bacterium *Salmonella typhimurium* and linked it to the plasmid of *E. coli*.
- iii. Cohen and Boyer are known as father of genetic engineering.
- iv. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.
- v. Endonucleases remove nucleotides from the ends of the DNA whereas exonucleases make cuts at specific positions within the DNA.
- vi. YAC vectors contain the telomeric sequence, the centromere and autonomously replicating sequence from yeast chromosomes.
- vii. Humulin was the first recombinant DNA, based product, produced and marketed in India.
- viii. Alkaline phosphatase, is used to- prevent unwanted self ligation of the vector DNA molecules in procedures of rDNA technology.
- ix. pBR322 vector was the first artificial ideal vector constructed by Boliver and Rodriguez.
- x. Plasmid DNA is coated with histone proteins and can act as genetic factor.

- (a) ii, iv, vi, x (b) ii, iv, v, x
- (c) i, ii, iv, vii, viii, ix (d) i, ii, iv, vi, x

15. Which of the following statement is not true.

- (a) Hind - II always cut DNA molecules at a particular point by recognizing a specific

sequence of 4 base pairs.

- (b) Besides Hind - II, today we know more than 900 restriction enzymes.
- (c) The name Eco RI comes from Escherichia coli - 13.
- (d) Type - II restriction endonuclease is most useful in genetic engineering

16. Which statement is incorrect?

- i. Genetic engineering is also called recombinant DNA technology
- ii. Bacteriophage is not used as vector
- iii. MALAYALAM is a palindrome
- iv. Ethidium bromide can not be used for staining DNA

17. A mixture containing DNA fragments A,B,C, and D with molecular weights, $A+B=C$, $A>B$ and $D>C$, was subjected to agarose gel electrophoresis. The position of these fragments from anode to cathode sides of gel should be:

- (a) A, B, C, D (b) B, A, C, D
- (c) B, A, D, C (d) C, D, A, D

18. Read the following statements carefully and select the correct option :-

- i. Source of the restriction enzyme Hind III is *Haemophilus influenzae*
- ii. In biolistic method of gene transfer, microparticles made up of gold or tungsten are coated with foreign DNA
- iii. Micro-injection method for injecting recombinant DNA is used for animal cell.
- iv. Primers are chemically synthesized Oligonucleotides that are complementary to the regions of DNA in PCR

How many of the above statements are correct ?

- (a) Four (b) Three (c) Two (d) One

19. Choose correct statement

- (a) Presence of more than one recognition site for one enzyme within vector generate several fragments, which will complicate gene cloning
- (b) Ligation of alien DNA is carried out at a restriction site present in Ori

- (c) In pBR322 one antibiotic resistance gene helps in selecting the transformants, whereas the other helps in cloning
- (d) Rop codes for proteins involved in ligation of foreign DNA

20. Consider the following statements

- i. Pure DNA fragments in agarose gel can be seen by naked eyes in UV light & without staining
- ii. DNA is a hydrophilic molecule
- iii. Separated DNA fragments are visualized after staining the DNA with ethanol and using UV light
- iv. Presence of more than one same recognition sites within vector will generate several fragments of vector, which will complicate gene cloning

Which of the following statement are correct?

- (a) i, ii & iii (b) ii, iii & iv
- (c) ii & iv (d) i, ii, & iv

21. Molecular probes used for identification of recombinant clone carrying the desired DNA insert can be

- i. Denatured double stranded DNA probes.
- ii. double stranded RNA probes.
- iii. Protein Probes.
- iv. Single stranded DNA probes

- (a) ii, iii (b) i, iv
- (c) i, ii (d) All of these

22. A research fellow performs following steps in a Southern blot experiment to determine the number of copies of a particular gene that has been inserted in a genetically modified organism.

- i. Transfer of DNA to nitrocellulose membrane.
- ii. Create radioactive probe.
- iii. Incubate probe and membrane
- iv. Restriction digestion of genomic DNA.
- v. Cleaved DNA separated using gel electrophoresis.

Which is the correct sequence to the above steps?

- (a) ii→iii→i→iv→v (b) ii→iii→i→v→iv
- (c) iv→v→i→ii→iii (d) v→iv→iii→ii→i

23. Read the following four statements (i-iv) and select the incorrect ones.

- i. Downstream processing is one of the steps of rDNA technology.
- ii. Disarmed pathogen vectors are also used in transfer of rDNA into the host.
- iii. The first transgenic buffalo, Rosie produced milk which was human alpha-lactalbumin enriched.
- iv. Restriction enzymes are used in isolation of DNA from other macromolecules.

Which of the two statements have mistakes?

- (a) ii and iii (b) iii and iv
- (c) i and iii (d) i and ii

24. Selection of recombinants due to inactivation of antibiotics is a cumbersome procedure because

- (a) It requires plating of one plate having certain antibiotics
- (b) It requires plating of two plates having same antibiotics
- (c) It requires simultaneous plating on two plates having different antibiotics
- (d) None of these

25. What is true about the first case of constructing a recombinant DNA-

- i. It was performed in 1979
- ii. It was performed by Stanley Cohen and Herbert Boyer
- iii. It was a transfer of an antibiotic resistant gene
- iv. Gene was transferred from *Salmonella typhimurium* into *E.coli*
- v. Gene could not replicate successfully in the target bacterium

- (a) i and v (b) i, ii and iii
- (c) ii, iii and iv (d) iii, iv and v

26. Read the following statements regarding DNA polymerase used in PCR :-

- i. It is isolated from thermosensitive bacteria
- ii. It remains active at high temperature
- iii. It is used to ligate introduced DNA in recipient cells.

- iv. It serves as a selectable marker

How many statements are correct ?

- (a) One (b) Two (c) Three (d) Four
27. Which of the following statement is correct in the context of observing DNA fragments separated by agarose gel electrophoresis?
 (a) Ethidium bromide stained DNA can be seen under exposure to UV light
 (b) DNA can be seen in visible light
 (c) DNA can be seen without staining in visible light
 (d) Ethidium bromide stained DNA can be seen in visible light
28. Eukaryotic genes may not function properly when cloned into bacteria because of
 (a) Destruction by native endonucleases.
 (b) Inability to excise introns.
 (c) Failure of promoter to be recognized by bacterial RNA polymerase.
 (d) All of the above.
29. While preparing for gel electrophoresis, percentage of Agarose increased from 10-20%. This would result in
 (a) Increased pore size
 (b) DNA fragment move fast
 (c) Decrease in pore size
 (d) Both (a) & (b)

ANSWER KEY**Microbes In Human Welfare**

- | | | | | |
|--------------|--------------|--------------|--------------|--------------|
| 1. b | 2. a | 3. a | 4. a | 5. a |
| 6. b | 7. b | 8. a | 9. a | 10. d |
| 11. b | 12. a | 13. d | 14. d | 15. d |
| 16. a | 17. d | 18. a | 19. a | 20. a |
| 21. a | 22. a | 23. a | 24. a | 25. b |
| 26. b | 27. c | 28. b | 29. a | 30. c |
| 31. d | 32. b | 33. c | 34. c | 35. d |
| 36. c | 37. c | 38. b | 39. b | |

Biotechnology And Its Principles

- | | | | | |
|--------------|--------------|--------------|--------------|--------------|
| 1. b | 2. a | 3. b | 4. a | 5. d |
| 6. b | 7. a | 8. d | 9. a | 10. c |
| 11. b | 12. c | 13. a | 14. c | 15. a |
| 16. a | 17. b | 18. a | 19. a | 20. c |
| 21. b | 22. c | 23. b | 24. c | 25. c |
| 26. b | 27. a | 28. b | 29. c | |

HINTS & SOLUTIONS**Microbes In Human Welfare**

- 1. (b)** Two microbes found to be very useful in genetic engineering are Escherichia coli and Agrobacterium tumefaciens
- 2. (a)** Acetobacter aceti, Lactobacillus, Streptomyces, Methanobacterium are arranged based on least importance.
- 3. (a)** Tissue plasminogen activator is a serine protease found on endothelial cells involved in the break down of blood clots.
- 4. (a)** Antibiotics are modified to enhance their potency. They are called Semi synthetic antibiotic.
- 5. (a)** Because of the discovery of antibiotics in the twentieth century, a number of dreaded diseases have become eradicated.
- 6. (b)**
- 7. (b)**
- 8. (a)** Citric acid - Aspergillus niger, Butyric acid - Clostridium butyricum Proteases- Aspergillus oryzae, Lipases - Candida lipolytica.
- 9. (a)** In sewage treatment plant, major part of sludge is pumped into large tanks called Anaerobic sludge digesters.
- 10. (d)**
- 11. (b)** The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.
- 12. (a)** Activated sludge should have the ability to settle quickly so that it can be rapidly pumped back from sedimentation tank to aeration tank.
- 13. (d)** Formation of flocs means bacteria associated with the solid waste of the water.
- 14. (d)** To restrict enzyme mobility in a fixed space. The immobilized enzyme is attached to an inert
- 15. (d)** Trichoderma & Bacillus thuringiensis is used as biocontrol agents.
- 16. (a)** Biocontrol refers to use of biological

methods for controlling plant diseases and pests.

- 17. (d)** Beijernickia is a phyllosphere or rhizosphere nitrogen fixing bacteria.
- 18. (a)** Aulosira fertilissima is most active nitrogen fixer of rice fields.
- 19. (a)** Blue green algae, rhizobia and other N₂ fixing bacteria are used as biofertilizers.
- 20. (a)** Pollution from animal excreta and organic waste from kitchen can be most profitably minimized by using them for producing biogas.
- 21. (a)** Tertiary treatment is omitted if treated water is to be passed into rivers and streams.
- 22. (a)** i. Statins, ii. Cylosporine A, iii. Sterptokinase
- 23. (a)**
- 24. (a)**
- 25. (b)**
- 26. (b)**
- 27. (c)**
- 28. (b)**
- 29. (a)**
- 30. (c)**
- 31. (d)**
- 32. (b)**
- 33. (c)**
- 34. (c)**
- 35. (d)**
- 36. (c)**
- 37. (c)**
- 38. (b)**
- 39. (b)**

Biotechnology And Its Principles

- 1. (b)**
- 2. (a)**
- 3. (b)**
- 4. (a)**
- 5. (d)**
- 6. (b)** PCR is used in amplification of DNA. Restriction enzyme was first discovered in *E.coli* bacteria . Pvu I is a site on plasmid pBR322.
- 7. (a)** Plasmid is an extra chromosomal circular, self replicating, double stranded DNA, found generally in bacteria. Presence of plasmid gives certain traits to the host, one such trait is resistance to certain toxins and antibiotics. pBR322 is the first artificial cloning vector. It has 2 antibiotic resistance genes, Tetracycline (tet R) and ampicillin (ampR). When BamHI is used , DNA insert or ligated DNA will be placed within tet R gene making it non functional. Hence when foreign DNA is ligated BamHI in pBR322 , recombinant plasmid will show resistance to ampicillin only.
- 8. (d)**
- 9. (a)**
- 10. (c)**
- 11. (b)**
- 12. (c)** When same restriction enzyme is used, resultant DNA fragments will have same kind sticky ends since they identify the same sequence.
- 13. (a)**
- 14. (c)** Father of genetic engineering is Paul Berg. Endonuclease will make cuts at specific regions within DNA . Exonuclease will remove nucleotides from ends of DNA.
- 15. (a)** Hind II is the first identified restriction endonuclease Hind II will cut DNA molecule at particular point by recognizing specific sequence of six base pairs.
- 16. (a)**
- 17. (b)**
- 18. (a)** All the statements are correct.
- 19. (a)**
- 20. (c)**
- 21. (b)**
- 22. (c)**
- 23. (b)** First transgenic cow was named Rosie. Restriction enzymes are used to break DNA molecule.
- 24. (c)**
- 25. (c)**
- 26. (b)** DNA Polymerase used in PCR is Taq DNA Polymerase. It is extracted from thermophilic bacterium *Thermus aquaticus*. Optimum Temperature for its functioning is 72° C. Taq DNA Polymerase will synthesize DNA between the primers in the process of PCR.
- 27. (a)**
- 28. (b)**
- 29. (c)**



NSEJS (Stage-1)

(2009-2010)

- The animal body is formed of many cells, but the cells show no coordination to form tissues in
 (a) protozoans
 (b) coelenterates
 (c) sponges
 (d) flat worms
- An indicator of pollution is
 (a) moss
 (b) lichens
 (c) algae
 (d) pteridophytes
- The one that CANNOT be used for DNA fingerprints is
 (a) leucocytes
 (b) erythrocytes
 (c) hair bulbs
 (d) sperms
- “Green fuel” means
 (a) fuel obtained from plant leaves
 (b) green coloured fuel
 (c) chemicals used for the growth of plants
 (d) fuel obtained from plastic waste
- Which one of the following is a true fruit ?
 (a) Pear
 (b) Coconut
 (c) Apple
 (d) Cashewnut
- The number of chromosomes can be counted at :
 (a) anaphase
 (b) interphase
 (c) metaphase
 (d) prophase
- Which one of the following is true fish ?
 (a) Star fish
 (b) Gold fish
 (c) Silver fish
 (d) Hag fish

- The part of the digestive system that digests lipids in the food is :
 (a) stomach
 (b) duodenum
 (c) ilium
 (d) large intestine

- During contraction of muscle fiber :

- I bands get reduced in length
- A bands retain the length
- I bands retain the length
- A bands get reduced in length

- What is true about white muscles ?

- Number of mitochondria is few.
- They possess very small quantity of myoglobin.
- The amount of sarcoplasmic reticulum is high
- They depend on anaerobic process of energy.

- In bacterial photosynthesis, usually :

- CO_2 is not fixed
- O_2 is not released
- H_2O is oxidized
- Chlorophyll traps light

(2010-2011)

- Bacteria cannot survive in a highly salted pickle because
 (a) they become plasmolysed and consequently die
 (b) they do anaerobic respiration
 (c) water is not available to them
 (d) of all the reasons mentioned above

- Cycas is classified as gymnosperm because of
 (i) presence of naked seeds
 (ii) lack of vessels in the xylem
 (iii) presence of sieve tubes
 (iv) fruit formation
 The correct reason is
 (a) (i) and (iv) (b) (i) and (iii)
 (c) (i) and (ii) (d) (ii) and (iii)
- Which one of the following is NOT poisonous?
 (a) spider (b) platypus
 (c) millipede (d) centipede
- The correct order of evolutionary advancement among the plants is
 (a) spirogyra → diatom hornwort → fern
 (b) blue green alga → liverwort → fern
 seed → bearing plant
 (c) liverwort → cyanobacterium → moss → gymnosperm
 (d) red alga → fern → moss → liverwort
- Lamina of a palm tree is dissected so as to adapt to
 (a) intense light
 (b) high wind velocity
 (c) scarcity of moisture
 (d) high temperature
- Which of the following pigments is different from others?
 (a) cyanoglobin (b) myoglobin
 (c) haemoglobin (d) cytochrome
- The feature indicating omnivorous nature of man is
 (a) presence of canines and molar
 (b) long intestine and vestigial appendix
 (c) ability to taste salty and sweet material
 (d) spacious stomach and caecum
- Considering the root system, the plant that has adapted to the arid conditions is
 (a) hydrilla (b) sunflower
 (c) hibiscus (d) khus
- The random motion of visible particles caused by the much smaller invisible particles of water is an example of
 (a) Brown motion (b) Brownian motion
 (c) Brownmat motion (d) Browniz's motion
- When a cell fails to communicate with other cells in multicellular organism, it
 (a) becomes cancerous
 (b) enters mitotic phase
 (c) chooses to die
 (d) is eaten up by other cells
- A desert room cooler cools better on hot and dry day due to
 (a) increase in the rate of evaporation
 (b) decrease in the rate of evaporation
 (c) decrease in the rate of vapourization
 (d) increase in the rate of diffusion
- The body of hydra is cut transversely into three pieces and the middle piece is kept upside down on the substratum. Then,
 (a) it fails to regenerate into an independent hydra
 (b) it would form tentacles and foot in the same locations as oriented
 (c) it would form tentacles and foot at the original upper and lower ends
 (d) it will form a hydra with tentacles at both the ends
- Maximum vitamin A content is likely to be found in the extract of
 (a) sprout of a pulse (b) cod liver
 (c) white muscles (d) rose petals
- Complete digestive juice having enzymes to digest all types of organic materials is secreted by
 (a) salivary gland and pancreatic gland
 (b) gastric gland and pancreatic gland
 (c) salivary gland and intestinal gland
 (d) pancreatic gland and intestinal gland
- The animal in which coelomic fluid has a significant role in locomotion is
 (a) earthworm (b) leech
 (c) crab (d) sea cucumber
- The tissue whose activity is important in vegetative propagation of a plant by grafting is
 (a) meristem (b) phloem
 (c) cambium (d) pith

17. An animal with chitinous exoskeleton, haemocoel and gills belongs to
 (a) aschelminthes (b) Arthropoda
 (c) Echinodermata (d) Urochordate
18. The ointment prescribed for burns usually contains, among other ingredients,
 (a) vitamin A (b) vitamin B
 (c) vitamin D (d) vitamin E
19. A child having protruding belly, bulging eyes, thin and curved legs and peeling skin is likely to be suffering from
 (a) kwashiorkor (b) rickets
 (c) marasmus (d) xerophthalmia

ANSWER KEY

(2009-2010)

1. c 2. b 3. b 4. a 5. b
 6. c 7. b 8. b 9. a, b
 10. a, b, c, d 11. b, d

(2010-2011)

1. a 2. c 3. c 4. b 5. b
 6. a 7. a 8. d 9. b 10. c
 11. a 12. c 13. b 14. d 15. a
 16. c 17. b 18. d 19. a

HINTS & SOLUTIONS

(2009-2010)

1.Sol: Sponges have cellular-level organization, meaning that their cells are specialized so that different cells perform different functions, but similar cells are not organized into tissues and bodies are a sort of loose aggregation of different kinds of cells.

2.Sol: Lichens are well known as sensitive indicators of air pollution, particularly for sulphur dioxide.

3.Sol: Although blood is an excellent source of DNA, the DNA does not come from the red blood cells, as these cells have no nuclei. Rather, the DNA comes chiefly from white blood cells in the blood.

4.Sol: Green fuel, also known as biofuel, is a type of fuel distilled from plants and is more environment friendly.

5.Sol: A true fruit or eucarp is a mature or ripened ovary, developed after fertilization. Here coconut is a true fruit whereas, rest are false fruits.

6.Sol: Metaphase in cells are characterized by the arrangement of chromosomes at the equatorial plane of the cell

7.Sol: Gold fish is a true fish. Starfish is an echinoderm, silver fish is an insect and hagfish is a cyclostome.

8.Sol: The small intestine is the major site for lipid digestion. There are specific enzymes for the digestion of triglycerides, phospholipids, and cleavage of esters from cholesterol.

9.Sol: When a sarcomere contracts, the Z lines move closer together, and the I band becomes smaller however, the A band remains constant.

10.Sol: These muscle fibres are lighter in colour as they do not have myoglobin. Mitochondria are less in number. White muscles have more sarcoplasmic reticulum. They depend mainly on anaerobic oxidation (glycolysis) for energy production and accumulate lactic acid in considerable amounts during strenuous work and soon get fatigued.

11.Sol: The photosynthetic bacteria are oxygenic as they do not evolve O₂ during photosynthesis and have comparatively simple photo transduction machinery with only one type of photosystem and reaction centre. The bacterial chlorophyll traps light like normal chlorophyll.

(2010-2011)

1.Sol: Salting is used because most bacteria, fungi and other potentially pathogenic organisms cannot survive in a highly salty environment, due to the hypertonic nature of salt. Any living cell in such an environment will become dehydrated through osmosis and die.

2.Sol: Gymnosperms are seed-bearing vascular plants, in which the ovules or seeds are not enclosed in an ovary.

3.Sol: Millipedes are not poisonous, but many species have glands capable of producing irritating fluids that may cause allergic reactions in some individuals.

4.Sol: The evolution of plants occurred in the following sequence- blue green alga → liverwort → fern seed → bearing plant.

5.Sol: The dissected lamina in palms is an adaptation to high wind velocity.

6.Sol: Cyanoglobin is a hemeprotein, found in certain cyanobacteria whereas, myoglobin is an iron- and oxygen-binding protein found in the muscle tissue of vertebrates and haemoglobin is a red protein responsible for transporting oxygen in the blood of vertebrates. Cytochromes occur in all organisms except a few obligate anaerobes.

7.Sol: Presence of incisors, canines, molars and premolars are substantial evidence to say that humans are omnivores.

8.Sol: The root system of Khus is finely structured and very strong. Its extensive root system tends to grow deep up to 4 metre.

9.Sol: Brownian motion is the random motion of particles suspended in a fluid resulting from their collision with the fast-moving molecules in the fluid.

10.Sol: When communication between cells get disrupted then the affected cell chooses to die in multicellular organisms.

11.Sol: A desert cooler cools better on a hot dry day because on a hot dry day temperature is high and humidity is less which helps in better evaporation. Due to the higher rate of evaporation it gives better cooling effect.

12.Sol: Regeneration among hydra occurs as foot regeneration arising from the basal part of the body, and head regeneration, arising from the apical region.

13.Sol: Cod liver oil is highly nutritious, as it can provide 90% of our daily requirements for vitamin A.

14.Sol: The pancreas and glands of intestine release juices containing several enzymes that break down carbohydrates, fats, and proteins in food.

15.Sol: The coelomic fluid of annelids plays a role in many important functions — e.g., locomotion and regulation of fluid transfer through the body wall.

16.Sol: Cambium is essential for grafting in plants because cambia which consists of meristematic cells of stock and scion fuse together.

17.Sol: An arthropod has a chitinous exoskeleton, haemocelomic coelom and gills for respiration.

18.Sol: Vitamin E is present in ointments prescribed for burns as they have a faster healing effect.

19.Sol: Kwashiorkor is a form of acute malnutrition that most commonly occurs in children.



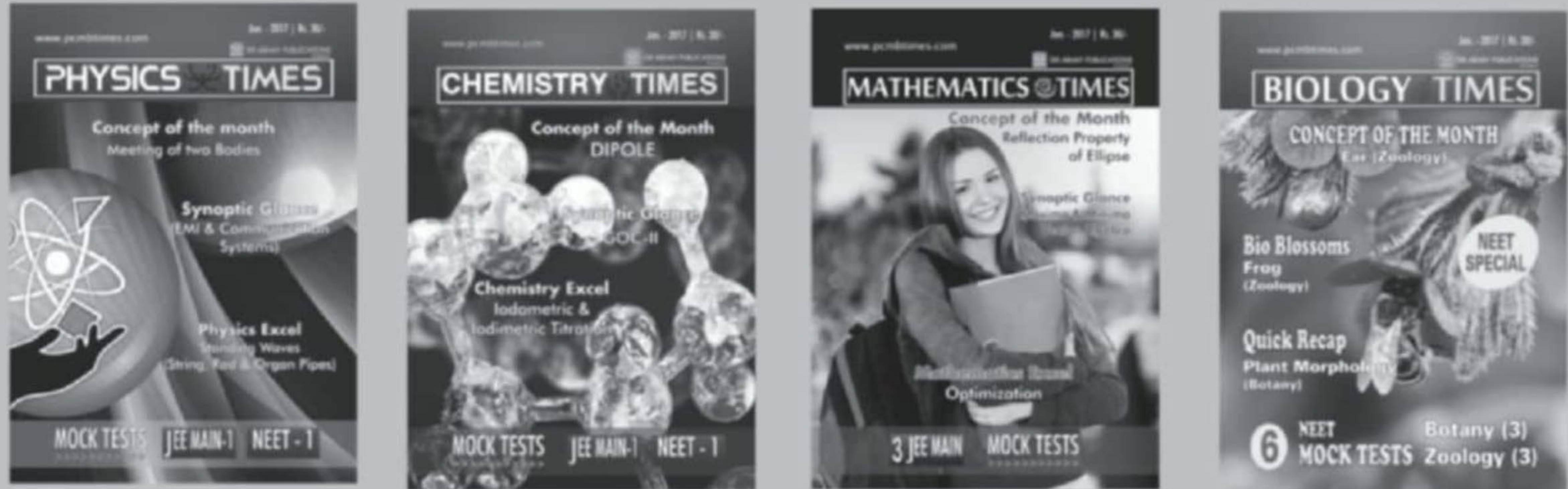
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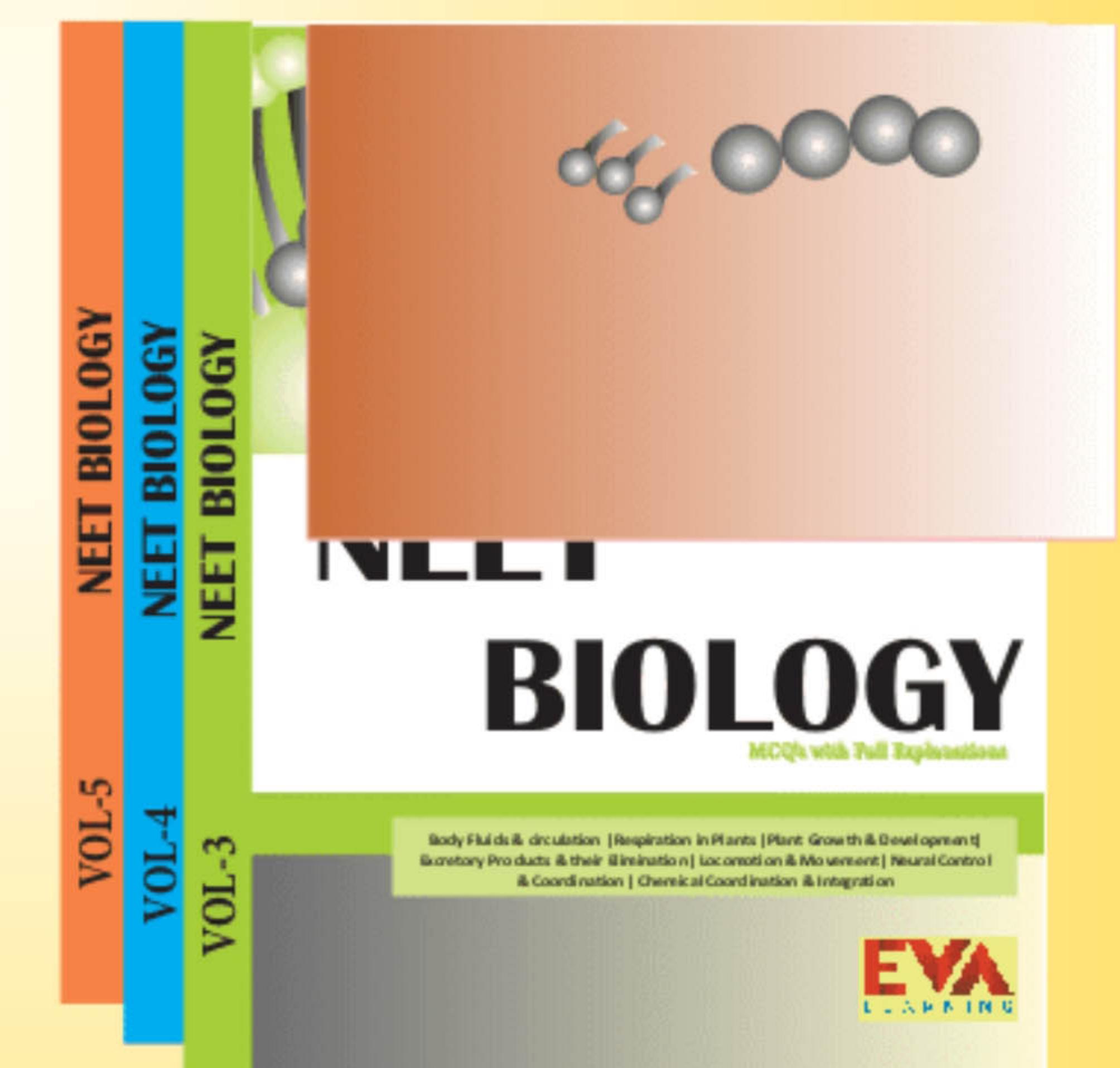
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